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MISCELLANIES.—DOMESTIC AND FOREIGN.

ERRATA.

Page 124, for *Track No. IV.* read *No. V.*, and for *Track No. V.* read *No. IV.*; these numbers and their paragraphs should have been thus transposed, in order to agree with the map.—P. 126, l. 13 fr. top, after *appears*, insert *not*.—P. 128, l. 2 fr. bot. for *basis*, read *basin*.—In the note, p. 129, l. 6 fr. bot. after *by*, insert *the displacement of*.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Miscellaneous Observations made during a tour in May, 1835, to the Falls of the Cuyahoga, near Lake Erie:* extracted from the Diary of a Naturalist.

The spring being the most desirable season of the year for traveling, when the mild weather, the fresh green foliage of the forest, and the opening flowers, entice one forth to enjoy their various beauties, I embarked at 9 o'clock on a pleasant evening in May, on board the steam boat Detroit, for a visit to the falls of the Cuyahoga.

Steam Boats.—It is now nearly twenty years since the first boat, propelled by steam, was launched upon the western waters. It was built by Capt. Shreeve, at Brownsville, (Pa.) in that region of country where the earliest improvements were made west of "the mountains." It was considered, at that time, as a doubtful experiment. The current of the Mississippi was said to be too powerful to be overcome by steam. The upward commerce on the Ohio and Mississippi, even at that period very considerable, was carried on wholly, in barges and keel boats, propelled by human strength, applied through the cordelle, oar, and pole. The voyage then occupied from three to four months: it is now performed in ten or twelve days. This boat was named the Washington; while lying at Marietta, on her downward voyage, she met with a very serious disaster, in the explosion of her immense boiler, by which accident twelve men lost their lives, and as many more were very seriously scalded. Being called immediately on board, to attend on the wounded, I recollect the horrors of that morning, as if it were but of yesterday. At this day few accidents of the kind happen on the Ohio. The engines are better constructed, and built of more durable materials.

Instead of one immense boiler, the boats now carry from four to six of a moderate capacity. The engineers are better educated, and are often chosen from among the architects of the boats. The boats now employed on the river between Louisville and Pittsburgh, amount to nearly one hundred. Many of these are kept in the best order, and for neatness and accommodation, may be safely compared with any boats in America. The crews are subjected to much more strict discipline, since that lawless, independent, but hardy race of keel-boat-men, from whom the hands were formerly chosen, have disappeared from our waters. The genteel manners and civil deportment of most of the passengers, have also a silent, but a sure and perceptible influence on the manners of the crew. Good habits, as well as bad, are easily adopted; and, above all, the banishment of whiskey, that bane of the west, from many of the boats, is doing still more than all other causes combined, for the improvement of morals, as well as of manners.

Sun-fish Creek.—At nine o'clock this morning, the boat passed the mouth of Sun-fish Creek, a small stream falling into the Ohio from the right bank. The hills here are nearly three hundred feet high, much broken and divided by deep ravines into isolated masses. They are now clothed to their very summits with the richest verdure of the forest, and at this season are displaying the various tints of the different species that cluster around their sides—the pure white of the Cornus florida, and the rich pink of the Celtis Ohioensis, now in full bloom, appears beautifully contrasted with the rich green of the woodlands. For the painter, this spot affords some of the finest views that are to be found on the Ohio. The river makes an abrupt bend opposite the mouth of the creek, and opens an extensive perspective of the richest scenery, both up and down the stream. The creek itself is lined with beautiful hills and shady ravines, some of which have given employment to the pencil of Mr. Sullivan, who has produced several masterly pieces taken from this vicinity. He is almost the only painter who has taken living views from the enchanting landscapes of the Ohio. This summer he proposes visiting the cliffs of New River and the valley of the Greenbrier, where some of the most sublime and grand scenery has rested for ages, unnoticed and unknown, except to the passing traveller, or the hunter, while chasing the deer amidst these lovely solitudes. No country possesses more rich or varied scenery, than the mountain regions on the tributary streams of the Ohio; in grandeur they may be excelled by the alpine groups of the globe, but in loveliness they are not surpassed.

Grave Creek.—At 11, A. M., we passed the mouth of Grave Creek, a beautiful stream, emptying into the Ohio on the left bank, ten miles below Wheeling. It rises in the high lands between the Monongahela and Ohio, near the great coal deposits found in that region. The name is derived from the great mound, which stands on the second or higher alluvions, not far from the creek. It is said to be nearly seventy feet high, with a proportionate base; and is the largest known on the banks of the Ohio. Several curious copper relics have been taken from its sides, but nothing has yet been discovered which points to the period or the character of its ancient founders. The bottoms at this spot are very wide and rich, and early attracted the notice of the first settlers.

Bituminous Coal.—The coal in this vicinity is very abundant and fine. Four miles below, or at the mouth of Pipe Creek, the main coal deposit, nearly six feet in thickness, which at Wheeling is ninety feet above the bed of the Ohio, dips beneath its surface; and is seen no more in any considerable deposit, until it appears at Carr's Run, sixteen miles above the mouth of the Big Kenawha, at what is now called "Pomeroy's Coal Beds."

Wheeling.—The boat landed at Wheeling at noon. This town is built on elevated ground, in a commanding situation, the land back of it rising abruptly in a bold ridge to the height of one hundred and eighty feet. A large and beautiful island in the Ohio, opposite to the town, adds much to the interest of the scenery as you approach it by water. It is a flourishing commercial, manufacturing place, with a population of about eight thousand. The leading citizens are noted for their enterprize and activity in business, having doubtless inherited this characteristic from its first inhabitants, who were amongst the most hardy, brave and active pioneers of the west.

Indian Attacks on Wheeling.—The spot of ground where Wheeling now stands was explored in the year 1769, by Col. Ebenezer Zane, and his brothers Silas and Jonathan Zane, and permanently settled the following year. They removed here from the "south branch of the Potomac," near to where the town of Morefield now stands. The ancestors of the Zane family came over with William Penn, at the first settlement of Philadelphia. Col. Zane built his first house on an eminence opposite to the island, which spot is now near the center of the town, and is still owned by his descendants. The Swearingens, Shepherds, McCullocks, and John Wetzel, the

father of Lewis, who was famous in the legends of hunting, and of Indian warfare, were amongst the first settlers of this place. Being, for many years during the Indian wars, the farthest advanced on the frontier, and the most exposed settlement, it suffered much from Indian depredations. It sustained two memorable seiges from the savages, the inhabitants defending themselves with the greatest bravery.

Attack of 1777.—The first assault was in Sept. 1777; when it was attacked by 380 Indians, headed by the notorious Simon Girty. Col. Zane, with thirty three men, assisted by the women, several of whom stood by the sides of their husbands or lovers, and discharged their rifles with fearless intrepidity. Amongst the females was Betsy Wheat, a young woman of German extraction: when Girty urged the garrison to surrender, promising quarters, &c., and there was a parley amongst the men, as to what was best to be done, Betsy answered Girty with all the keenness of female irony, shamed such of the men as seemed disposed to surrender, and infused fresh courage into the disheartened garrison. The siege was continued for twenty four hours, during which time the Indians kept up a constant fire. Seeing no prospect of success, and fearing an attack themselves from the neighboring garrisons, they retreated, after destroying nearly three hundred head of cattle, horses and hogs, and burning the houses in the village, then amounting to about twenty five dwellings. The consequent distress of the inhabitants was very great, as most of them lost not only their furniture and provisions, but all their clothing, excepting what they had on; the suddenness of the attack giving them no time to remove any thing to the fort but their own persons. In this siege some of the garrison were wounded, but none killed; the main loss fell on a reconnoitering party, who, having gone out early in the morning, were ambushed by the Indians, and twenty three of the number killed in sight of the fort. The loss sustained by the savages was never certainly known.

Attack of 1782.——The second attack took place in the year 1782. In its results, this siege was less disastrous to the whites than the first. The assault was continued for three days and nights, and the defense conducted by Col. Ebenezer and Silas Zane, with their accustomed coolness and bravery. An interesting occurrence took place during this siege, so characteristic of the heroism of the females of that day, that I cannot forbear narrating it from the "Border Warfare." "When Lynn, the ranger, gave the alarm that an

Indian army was approaching, the fort having been for some time unoccupied by a garrison, and Col. Zane's house having been used for a magazine, those who retired into the fortress had to take with them a supply of ammunition for its defense. The supply of powder, deemed ample at the time, was now almost exhausted, by reason of the long continuance of the siege, and the repeated endeavors of the savages to take the fort by storm: a few rounds only remained. In this emergency, it became necessary to renew their stock from an abundant store which was deposited in Col. Zane's house. Accordingly, it was proposed that one of the fleetest men should endeavor to reach the house, obtain a supply of powder, and return with it to the fort. It was an enterprize full of danger; but many of the heroic spirits shut up in the fort were willing to encounter the hazard. Amongst those who volunteered to go on this enterprize, was Elizabeth, the sister of Col. E. Zane. She was young, active and athletic, with courage to dare the danger, and fortitude to sustain her through it. Disdaining to weigh the hazard of her own life against that of others, when told that a man would encounter less danger by reason of his greater fleetness, she replied, "and should he fall, his loss will be more severely felt; you have not one man to spare; a woman will not be missed in the defense of the fort. Her services were then accepted. Divesting herself of some of her garments, as tending to impede her progress, she stood prepared for the hazardous adventure; and when the gate was thrown open, bounded forth with the buoyancy of hope, and in the confidence of success. Wrapt in amazement, the Indians beheld her springing forward, and only exclaiming "a squaw," "a squaw," no attempt was made to interrupt her progress: arrived at the door, she proclaimed her errand. Col. Silas Zane fastened a table cloth around her waist, and emptying into it a keg of powder, again she ventured forth. The Indians were no longer passive. Ball after ball whizzed by, several of which passed through her clothes: she reached the gate, and entered the fort in safety;" and thus was the garrison again saved by female intrepidity. "This heroine had but recently returned from Philadelphia, where she had received her education, and was wholly unused to such scenes as were daily passing on the frontiers. The distance she had to run was about forty yards. She afterwards married a Mr. Clark, and is yet living in Ohio."

Wellsburgh.—The boat left Wheeling at 1, P. M., passing many fine views of river scenery and flourishing villages, rising along its borders. At sixteen miles above, we passed the town of Wellsburgh, formerly called Charleston. The main coal deposit here has reached an elevation of at least one hundred and forty feet above the bed of the river. It is six feet in thickness, and of a very superior quality. The mouths of numerous adits are open on the sides of the river hill, from which the coal passes, by a wooden slide, down to the water's edge, or into the boats that are to carry it to a market below. This town is a place of considerable business, and has a cotton and glass manufactory. Large quantities of flour are manufactured here and on the neighboring streams, which afford many valuable mill sites. The surrounding country produces large and luxuriant crops of wheat, and boats laden with flour and whiskey were very early sent from this place to New Orleans, while yet owned by the Spaniards. While passing Wellsburgh we saw a keel boat lying at the shore, with the word Poe painted on her side; this is the name of a celebrated borderer who once lived near this spot, and whose fame is yet cherished, because he was one of the most daring Indian hunters in the days of border warfare. This region was the seat of Indian wars for more than twenty years, and in the space of fifty miles around, more depredations and murders were committed by the Indians, than in any other of equal extent west of the Alleghany Mountains. The celebrated "Mingo Bottoms" begin just above the town, and continue on both sides of the river to near Steubenville.

Steubenville.—At 6, P. M., the boat arrived at Steubenville, where I went on shore, intending to spend the day with a few intelligent friends who reside there. This town stands on an elevated plain on the right bank of the Ohio, and is "the Seat of Justice"* for Jefferson County. It was laid out into building lots in the year 1798, and for many years had a very rapid increase. Its present population is more than 3,000. The country adjacent is rich and well adapted to cultivation, being nearly all under culture. The surface is undulating, affording the finest soil for wheat and sheep. Messrs. Bezaleel Wells and Dickerson, introduced the merino sheep at an early day, and established an extensive manufactory for woolen cloths. It is at present a considerable manufacturing town, hav-

* The place where the Courts are held.

ing two woolen manufactories, two of cotton, three of carpetings, one paper mill, several founderies, three steam engine manufactories, one brass foundery, three flouring mills, one silver plate manufactory and three copperas manufactories, with many other mechanical operations usually carried on in our large western towns. There are three printing offices issuing weekly papers, six churches, one bank, one market house, and thirty trading stores. An abundant supply of bituminous coal is found in the adjacent hills for conducting all the various manufactures, and for domestic uses. The continual cloud of dust arising from its combustion, gives rather a sombre look to the buildings and streets, a feature, however, common to all manufacturing towns.

Cabinet of Natural History.—May 7: I spent a part of the forenoon in examining Judge T.'s Cabinet of Natural History. He has a fine collection of minerals, shells and fossil organic remains. The minerals embrace nearly twelve hundred species, arranged in natural families. The fresh water shells amount to nearly one hundred species, the greater number of which are peculiar to our streams. The family of the Uniones alone contains about ninety species, all natives of the western waters. His collection of marine shells is also very fine. The library of the Judge embraces, besides a due proportion belonging to his own profession, many of the most valuable writings of Cuvier and Brongniart, in their original language, on the animal kingdom, as well as fossil organic remains. It is truly gratifying to see even a small part of the wealth of our country, and a share of its most brilliant intellect, devoted to the study and the development of the natural history of "the west;" a subject deeply interesting, but until recently, shrouded in much darkness; within a few years, however, many bright lights have been kindled, which promise to illustrate the hidden arcana of nature. The Conchology and Botany of the great valley have been pretty thoroughly examined, while Entomology, one of the most fertile branches, has been but partially investigated, although the indefatigable Say made a very fair beginning. The study of fossil vegetable and animal remains, of which the valley of the Mississippi is one vast cemetery, yet remains an almost entirely unexplored field.*

* The readers of this Journal have only to refer to Volume XXIX. No. 1. to see ample evidence, furnished by Dr. Hildreth, that much has been accomplished by him and his friends, able pioneers in this wide and rich field of nature.—*Ed.*

But the time is not distant, when this vast cabinet of natural history, formed by a benevolent Creator for the study and admiration of man, will be classed and arranged by our own naturalists. Amongst the minerals in the cabinet of Judge T. I observed a specimen of native cinnabar, or sulphuret of mercury, in acicular crystals, being a fragment of a rolled mass of nearly a pound weight. This rare and beautiful mineral was found on the waters of Paint Creek, amongst the debris and rolled masses of primitive rocks, which abound through the tertiary deposits,* from Chilicothe to the shores of Lake Erie, and must have been brought from the region north of Lake Huron or Superior.

Ancient Indian Sepulchre.—The day before I reached Steubenville, an extensive collection of human skeletons, in a fine state of preservation, had been found on the opposite side of the Ohio River, a few rods from the shore, and nearly against the lower part of the town. They were very probably placed here by the Mingo tribe of Indians, who for many years inhabited this spot and the country below, which still retains the name of "the Mingo Bottom." This natural sepulchre was accidentally discovered by a man who was working in a stone quarry. The loose stones and earth had slipped down from the side of the hill above, and covered the mouth of the cavern. It had also been closed by the depositors of the dead, with fragments of sandstone rock, not only to secure it from the entrance of wild beasts, but also from the curiosity of the white man, after they had been forced to leave the country of their forefathers. The sepulchre, or rather natural grotto, in which the skeletons were placed, was originally formed in the face of the cliff above, by the action of the atmosphere decomposing the rock. Its constituent elements, oxygen and nitrogen, either entered into combination, or, the oxygen alone, by combining with the nitrogen of animal matter, thus formed nitric acid, and the latter, acting on the lime contained in the sandstone, produced nitrate of lime; thus the cohesion of the particles of sand was destroyed, which, as the minute crystals shot into form, was detached and then fell down to the earth below, forming large piles at the base of the cliffs. In these piles I have

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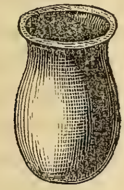
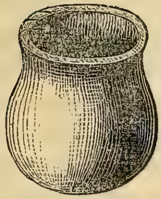
* I know no term, more appropriate, for the immense deposits of clay, sand, and gravel, which compose the western prairies, than that of tertiary: they embrace all the characteristics of this formation, and if they do not rest on chalk, and cannot be called supercretaceous, they rest on lime rocks which belong to the secondary deposits, and in a geological view, these unconsolidated beds are strictly tertiary.

often seen the myrmelion formicarius, or ant-lion, form its cone-inverted cells for the capture of unwary insects.

Rains, frosts and winds, assist in the disintegrating process. In this manner large excavations have been formed, and are still forming, in the faces of the river cliffs, along the narrows of the Ohio. Large masses of these cliffs are detached, from time to time, and fall down the sides of the declivities into the bottom below, or rest on the sides of the hills. The rock under which these relics were found is of this description:—as it rolled down the side of the hill, it rested with the oven shaped cavity underneath, being about eight feet long, six wide, and five high in the centre, but lower at the sides. A small opening however was left, which by a little enlargement enabled the Indians to enter and deposit these skeletons, which are not less than fifty or sixty in number. They were of all ages, and of both sexes, and generally in a perfect state of preservation. They are most probably of very ancient sepulture, as no relics, implements or ornaments of a metallic nature, were discovered. Many interesting memorials of their own arts, and of their affection for their relatives, were found, consisting of pots and vases of coarse earthen ware; some of them were formed with much taste and beauty of outline. The figures of two of them now in my possession are given below.

No. 1.  Is 8 inches high; 5 inches in diameter at the broadest part, and 4½ inches at the neck.

No. 2.  Is 6 inches high; 6 inches in diameter in the largest part, and 5 inches at the top.

They were of various magnitudes, from the capacity of a gallon down to a pint, and would amount in number to not less than one for every two skeletons, or thirty or forty pots, several being broken in taking out. A number of the vases still contained relics of the food, consisting of the bones of turkies, opossums, &c., left for their

departed friends while on their journey to the land of spirits. Stone pipes, more numerous than the vases, were also found; some of them display much ingenuity: one of them, which I saw, was carved with a fine head of the bald eagle, done with great force and truth: others were plain, made of light ash colored steatite, or soap stone. A few were of red clay, and some of hard sandstone. Flint arrow heads were very numerous. A very few of the crania exhibited marks of violence. They appear, in general, to have died a natural death, and the bones to have been deposited here after being carefully cleared of the flesh that once covered them. The sepulchre is too small and too confined to have received them with the flesh on, or to have admitted the friends of the dead without danger of suffocation. I succeeded, with some difficulty, in procuring two crania, for the most of them had been carried off before I reached the place. One is the head of a male, the other of a female. In the male, the organs of self esteem and combativeness are largely developed. It is perfect, and of as good a color as most skulls preserved in the cabinets of the anatomists. The female head is well formed, and possesses some good points in the estimation of the craniologist.

The "Mingo Bottom," which commences a short distance below, was the favorite residence of this once powerful tribe, when the white man first made his appearance west of the Alleghany ranges. The body of Logan, the celebrated chief, whose name has become classical and is identified with history by the pen of Thomas Jefferson, is said to have been buried on one of the adjacent hills, in sight of the placid and beautiful Ohio, on whose waters he had so often struck the voracious pike with his fishing spear, and hunted the buffalo and the deer in the forests which shaded its shores.

Henry Jolly.—While on the subject of the Mingoes, I cannot refrain from reverting to that much controverted subject, the murder of Logan's family. The following facts are very valuable and interesting, as coming from the pen of one who saw the party the evening after the murder; was personally acquainted with some of the individuals, and familiar with that spot and all the surrounding region. The statement is from the manuscript notes of Mr. Henry Jolly, now in my possession, and written at my request. Mr. Jolly is seventy seven years of age, and lived during his youth and early manhood on the Monongahela frontiers. At the period of this event, his parents resided on the spot where the town of Washington, Pa., now stands, and which was then known to all the country

as "Catfish's Camp," so named after an old Indian who resided there at the time the whites first settled on the Monongahela. This place is about thirty miles in a south westerly direction from the mouth of Yellow Creek, or "Baker's Bottom," opposite to the creek where the tragedy was acted. Henry Jolly was then sixteen years old. A large portion of the time during the war of the revolution, he was in the U. S. service, as a rifleman and ranger. Some time after the peace he removed to Ohio, and was for a number of years an Associate Judge on the bench of Washington County. He never received any advantages from schools, and yet was a man of extensive reading and general knowledge of mankind. I shall have occasion to refer to him again. The statement cannot be better given than in his own words.

Murder of Logan's family.—"I was about sixteen years of age, but I very well recollect what I then saw, and the information that I have since obtained, was derived from (I believe) good authority. In the spring of the year 1774, a party of Indians encamped on the north west of the Ohio, near the mouth of the Yellow Creek. A party of whites, called 'Greathouse's party,' lay on the opposite side of the river. The Indians came over to the white party, consisting, I think, of five men and one woman, with an infant. The whites gave them rum, which three of them drank, and in a short time they became very drunk. The other two men and the woman refused to drink. The sober Indians were challenged to shoot at a mark, to which they agreed; and as soon as they had emptied their guns the whites shot them down. The woman attempted to escape by flight, but was also shot down; she lived long enough, however, to beg mercy for her babe, telling them that it was a kin to themselves. The whites had a man in the cabin, prepared with a tomahawk for the purpose of killing the three drunken Indians, which was immediately done. The party of men then moved off for the interior settlements, and came to 'Catfish Camp' on the evening of the next day, where they tarried until the day following. I very well recollect my mother feeding and dressing the babe; chirruping to the little innocent, and its smiling. However, they took it away, and talked of sending it to its supposed father, Col. George Gibson, of Carlisle, Pa., 'who was then, and had been for many years, a trader amongst the Indians.' The remainder of the party at the mouth of Yellow Creek, finding that their friends on the opposite side of the river were massacred, attempted to escape by descending the Ohio;

and in order to prevent being discovered by the whites, passed on the west side of Wheeling Island, and landed at Pipe Creek, a small stream that empties into the Ohio a few miles below Grave Creek, where they were overtaken by Cresap, with a party of men from Wheeling.* They took one Indian scalp, and had one white man (Big Tarrener) badly wounded. They, I believe, carried him in a litter from Wheeling to Redstone. I saw the party on their return from their victorious campaign. The Indians had for some time before these events, thought themselves intruded upon by the 'Long Knife,' as they at that time called the Virginians, and many of them were for war. However, they called a council, in which Logan acted a conspicuous part. He admitted their grounds of complaint, but at the same time reminded them of some aggressions on the part of the Indians, and that by a war they could but harass and distress the frontier settlements for a short time; that 'the Long Knife' would come like the trees in the woods, and that ultimately they should be driven from the good lands which they now possessed. He therefore strongly recommended peace. To him they all agreed; grounded the hatchet, and every thing wore a tranquil appearance; when behold, the fugitives arrived from Yellow Creek: and reported that Logan's father, brother, and sister, were murdered! Three of the nearest and dearest relations of Logan, had been massacred by white men. The consequence was, that this same Logan, who a few days before was so pacific, raised the hatchet, with a declaration that he would not ground it until he had taken *ten* for *one;* which I believe he completely fulfilled, by taking *thirty* scalps and prisoners in the summer of 1774. The above has often been related to me by several persons who were at the Indian towns at the time of the council alluded to, and also when the remains of the party came in from Yellow Creek. Thomas Nicholson in particular, has told me the above and much more. Another person (whose name I cannot recollect) informed me that he was at the towns when the Yellow Creek Indians came in, and that there was great lamentation by all the Indians of that place.

* Cresap did not live at Wheeling, but happened to be there at that time with a party of men, who had, with himself, just returned from an exploring expedition down the Ohio, for the purpose of selecting and appropriating lands (called in the West, locating lands) along the river in choice situations; a practice at that early day very common, when Virginia claimed both sides of the stream, including what is now the State of Ohio.

Some friendly Indian advised him to leave the Indian settlements, which he did." "Could any rational person believe for a moment, that the Indians came to Yellow Creek with hostile intentions, or that they had any suspicion of similar intentions on the part of the whites, against them? Would five men have crossed the river, three of them become in a short time dead drunk, while the other two discharged their guns, and thus put themselves entirely at the mercy of the whites; or would they have brought over a squaw with an infant pappoos, if they had not reposed the utmost confidence in the friendship of the whites? Every person who is at all acquainted with Indians knows better; and it was the belief of the inhabitants who were capable of reasoning on the subject, that all the depredations committed on the frontiers, by Logan and his party, in 1774, were as a retaliation for the murder of Logan's friends at Yellow Creek. *It was well known that Michael Cresap had no hand in the massacre at Yellow Creek.*"*

Spring Garden.—During the day, I visited "the Spring Garden," owned by Mr. Slack, a very ingenious and enterprizing man. It is beautifully situated on the southern slope of a hill, looking down upon the Ohio. A large spring of very pure water bursts from the side of the hill, a part of which is diverted to the use of a bath house, and the remainder to the irrigation of the garden in the drier portions of the year. A green house is attached, containing many rare and rich exotics, now in fruit and flower. The situation is one of the best I have ever seen, and cannot fail to yield both profit and delight to the owner, and to afford a source of tasteful and refined recreation to the inhabitants of Steubenville. Indeed, horticulture, delighting us by its flowers, and rewarding us by its fruits, tends, manifestly, to cherish a refined taste in individuals, and to produce an elevated state of society; while agriculture confers upon mankind the most substantial rewards: the best days of Rome were those of her Cincinnati, when the tillage of the earth was considered equally useful and honorable. The Georgics of

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* A brother of Capt. Daniel Greathouse, said to have been present at the massacre, was killed by the Indians the 24th March, 1791, between the mouth of the Scioto and Limestone, while emigrating to Kentucky in a flat boat, with his family. He seems to have made little or no resistance to the Indians, who attacked him in canoes. They probably knew who he was, and remembered the slaughter of Logan's family, as he was taken on shore, tied to a tree, and whipped to death with rods.

Virgil have immortalized the Roman agriculture and horticulture, and produced a poem not only instructive, but highly attractive, and which, for eighteen centuries, has been a classical study.

After spending a very pleasant day, and receiving many marks of kindness and attention from my friends, I embarked on board the steam boat Hero, at 4, P. M., for the mouth of the Big Beaver River. This stream was so named on account of the great number of beavers found on its head branches, and in the small ponds from which some of its waters flow. It is a stream of considerable magnitude, abounding in valuable mill seats, and is destined to furnish a supply of water for that portion of the Ohio and Pennsylvania Canal which passes down its valley. The distance from Steubenville to Beaver is about forty miles.

*Adventure of Lewis Wetzel.**—Amongst the heroes of border warfare, Lewis Wetzel held no inferior station. Inured to hardships while yet in boyhood, and familiar with all the varieties of forest adventure, from that of hunting the beaver and the bear, to that of the wily Indian, he became one of the most celebrated marksmen of the day. His form was erect, and of that height best adapted to activity, being very muscular, and possessed of great bodily strength. From constant exercise, he could without fatigue, bear prolonged and violent exertion, especially that of running and walking; and he had, by practice acquired the art of loading his rifle when running at full speed through the forest, and wheeling on the instant, he could discharge it with unerring aim, at the distance of eighty or one hundred yards, into a mark not larger than a dollar. This art he has been known more than once to practice with fatal success on his savage foes.

A marksman of superior skill was, in those days, estimated by the other borderers, much in the same way that a knight templar, or a knight of the cross, who excelled in the tournament or the charge, was, valued by his cotemporaries, in the days of chivalry. Challenges of skill often took place; and marksmen who lived at the distance of fifty miles or more from each other, frequently met by appointment, to try the accuracy of their aim, on bets of considerable amount. Wetzel's fame had spread far and wide, as the most expert and unerring shot of the day. It chanced that a young man, a

* Received from a gentleman of my acquaintance, to whom one of the party related the story, a few years after the transaction took place; and with which my friend was also familiar from the narration of others.

few years younger than himself, who lived on Dankard's Creek, a tributary of the Monongahela River, which waters one of the earliest settlements in that region, heard of his fame, and as he also was an expert woodsman, and a first rate shot, the best in his settlement, he became very desirous of an opportunity for a trial of skill. So great was his desire, that he one day shouldered his rifle, and whistling his faithful dog to his side, started for the neighborhood of Wetzel, who, at that time, lived on Wheeling Creek, distant about twenty miles from the settlement on Dankard's Creek. When about half way on his journey, a fine buck sprang up just before him. He levelled his gun with his usual precision, but the deer, though badly wounded, did not fall dead in his tracks. His faithful dog soon seized him and brought him to the ground, but while in the act of doing this, another dog sprang from the forest upon the same deer, and his master making his appearance at the same time from behind a tree, with a loud voice claimed the buck as his property, because he had been wounded by his shot, and seized by his dog. It so happened that they had both fired at once at this deer, a fact which may very well happen where two active men are hunting on the same ground, although one may fire at the distance of fifty yards, and the other at one hundred. The dogs felt the same spirit of rivalry with their masters, and quitting the deer, which was already dead, fell to worrying and tearing each other. In separating the dogs, the stranger hunter happened to strike that of the young man. The old adage, "strike my dog, strike myself," arose in full force, and without further ceremony, except a few hearty curses, he fell upon the hunter and hurled him to the ground. This was no sooner done than he found himself turned, and under his stronger and more powerful antagonist. Discovering that he was no match at this play, the young man appealed to the trial by rifles, saying it was too much like dogs, for men, and hunters, to fight in this way. The stranger assented to the trial, but told his antagonist that before he put it fairly to the test, he had better witness what he was able to do with the rifle, saying that he was as much superior, he thought, with that weapon, as he was in bodily strength. He bid him place a mark the size of a shilling on the side of a huge poplar that stood beside them, from which he would start with his rifle unloaded, and running a hundred yards at full speed, he would load it as he ran, and wheeling, would discharge it instantly to the centre of the mark. The feat was no sooner proposed than

performed; the ball entered the centre of the diminutive target: astonished at his activity and skill, his antagonist instantly enquired his name. Lewis Wetzel, at your service, answered the stranger. The young hunter seized him by the hand with all the ardor of youthful admiration, and at once acknowledged his own inferiority. So charmed was he with Wetzel's frankness, skill, and fine personal appearance, that he insisted upon his returning with him to the settlement on Dankard's Creek, that he might exhibit his talents to his own family, and to the hardy backwoodsmen, his neighbors. Nothing loath to such an exhibition, and pleased with the energy of his new acquaintance, Wetzel consented to accompany him; shortening the way with their mutual tales of hunting excursions and hazardous contests with the common enemies of the country. Amongst other things, Wetzel stated his manner of distinguishing the footsteps of a white man from those of an Indian, although covered with mocasins, and intermixed with the tracks of savages. He had acquired this tact from closely examining the manner of placing the feet; the Indian stepping with his feet in parallel lines, and first bringing the toe to the ground; while the white man almost invariably places his feet at an angle with the line of march. An opportunity they little expected, soon gave room to put his skill to the trial. On reaching the young man's home, which they did that day, they found the dwelling a smoking ruin, and all the family lying murdered and scalped, except a young woman who had been brought up in the family, and to whom the young man was ardently attached. She had been taken away alive, as was ascertained by examining the trail of the savages. Wetzel soon discovered that the party consisted of three Indians and a renegado white man, a fact not uncommon in those early days, when, for crime or the love of revenge, the white outlaw fled to the savages, and was adopted on trial into their tribe.

As it was past the middle of the day, and the nearest assistance still at some considerable distance, and there were *only four* to contend with, they decided on instant pursuit. As the deed had very recently been done, they hoped to overtake them in their camp that night, and perhaps before they could cross the Ohio River, to which the Indians always retreated after a successful incursion, considering themselves in a manner safe when they had crossed to its right bank, at that time occupied wholly by the Indian tribes.

Ardent and unwearied was the pursuit, by the youthful huntsmen; the one, excited to recover his lost mistress, the other, to assist his new friend, and to take revenge for the slaughter of his countrymen—slaughter and revenge being the daily business of the borderers at this portentous period.* Wetzel followed the trail with the unerring sagacity of a blood hound; and just at dusk traced the fugitives to a noted war path, nearly opposite to the mouth of Captina Creek, emptying into the Ohio, which, much to their disappointment, they found the Indians had crossed, by forming a raft of logs and brush, their usual manner when at a distance from their villages. By examining carefully the appearances on the opposite shore, they soon discovered the fire of the Indian camp in a hollow way, a few rods from the river. Lest the noise of constructing a raft should alarm the Indians, and give notice of the pursuit, the two hardy adventurers determined to swim the stream a few rods below. This they easily accomplished, being both of them excellent swimmers; fastening their clothes and ammunition in a bundle on the tops of their heads, with their rifles resting on the left hip, they reached the opposite shore in safety: after carefully examining their arms, and putting every article of attack or defense in its proper place, they crawled very cautiously to a position which gave them a fair view of their enemies, who, thinking themselves safe from pursuit, were carelessly reposing around their fire, thoughtless of the fate that awaited them. They instantly discovered the young woman, apparently unhurt, but making much moaning and lamentation, while the white man was trying to pacify and console her with the promise of kind usage, and an adoption into the tribe. The young man, hardly able to restrain his rage, was for firing and rushing instantly upon them. Wetzel, more cautious, told him to wait until day light appeared, when they could make the attack with a better chance of success, and of also killing the whole party, but if they attacked in the dark, a part of them would certainly escape.

As soon as day light dawned, the Indians arose and prepared to depart. The young man selecting the white renegado, and Wetzel an Indian, they both fired at the same time, each killing his man. The young man rushed forward knife in hand, to relieve the young woman, while Wetzel reloaded his gun and pushed in pursuit of the two survivingIndians, who had taken to the woods, until they could ascer-

* Between 1782 and 1784.

tain the number of their enemies. Wetzel, as soon as he saw that he was discovered, discharged his rifle at random, in order to draw them from their covert. Hearing the report, and finding themselves unhurt, the Indians rushed upon him before he could again reload: this was as he wished: taking to his heels, Wetzel loaded as he ran, and suddenly wheeling about, discharged his rifle through the body of his nearest, but unsuspecting enemy. The remaining Indian, seeing the fate of his companion, and that his enemy's rifle was unloaded, rushed forward with all energy, the prospect of prompt revenge being fairly before him. Wetzel led him on, dodging from tree to tree, until his rifle was again ready, when suddenly turning, he shot his remaining enemy, who fell dead at his feet. After taking their scalps, Wetzel and his friend, with their rescued captive, returned in safety to the settlement. Like honest Joshua Fleeheart, after the peace of 1795, Wetzel pushed for the frontiers on the Mississippi, where he could trap the beaver, hunt the buffalo and the deer, and occasionally shoot an Indian, the object of his mortal hatred. He finally died as he had always lived, *a free man of the forest.*

Beaver town, Pa., May 8.—The boat arrived at the mouth of the Beaver* river, at 12, midnight, and landed me at "the point;" from this place it is about a mile to the town of Beaver, situated on an elevated plain, from seventy to eighty feet above the Ohio bottoms. This plain is about a mile in length and half a mile in width; and is an ancient alluvion, deposited by the Ohio river, at some remote period. The main body of it is composed of gravel and pebbles, with an argillaceous earth, at or near the surface, affording a tolerably good soil for cultivation and the growth of forest trees. Great numbers of sandstone bowlders are scattered over its surface, rounded and water worn by attrition; they are far more numerous than I have seen at any other place. The village of Beaver town, stands near the western side of the plain. It is the county seat for Beaver county, Pa., and contains about eight hundred inhabitants. A new town called Bridgewater, has been laid off on the canal, a short distance above the outlet, which is destined to take precedence in mercantile business of the present village of Beaver town.

Fort McIntosh.—Fort McIntosh, one of the earliest, if not the very first fort, built by the Americans on the right bank of the Ohio,

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* According to Mr. Heckewelder, the Big Beaver river, was called by the Delaware Indians, Kaskask-sipee, from the Indian town of Kuskuschki.

stood on the southern verge of the plain, about twenty rods from the bank of the river, with which it held communication, by means of a covered way. This covered way, was constructed in a very simple but perfectly secure manner, by digging a ditch and covering it with oaken palisades, sloping towards each other like a roof, and then coated over with earth—an attempt had been made to dig a well within the walls of the fortress, but the depth of earth and gravel to be passed before reaching water was so great, being about one hundred and twenty feet, that it was abandoned, and this mode adopted in its place. Water for the garrison was first procured from a spring at the back side of the plain, but several of the men having been killed by the Indians while at the spring, this mode of obtaining a supply was given up as too hazardous, and the covered way was adopted in its place. Fort McIntosh was built during the war of the revolution, in the summer of the year 1778, by a military force from Fort Pitt, under the command of Gen. McIntosh. It covered about an acre of ground; and was a regularly stockaded fort, with four bastions, mounted with six field pieces, from four to nine pounders; one piece was placed in each bastion, and two in the centre of the fort. It was twenty eight miles below Fort Pitt, and at a favorable point for checking the incursions of the Indians, or for sending out parties in pursuit, while on the retreat from an inroad into the white settlements on the Monongahela. It was for a number of years the rallying point for the borderers, when assembling for array, against the Indian towns on the Muskingum and Scioto rivers.

Samuel Brady.—I left Beavertown in the mail coach, at 11 A. M. for Poland, in Trumbull County, Ohio, distant thirty eight miles. Directly on leaving Bridgewater, and crossing a small stream, on a neat bridge, we began to ascend a long steep hill, called "Brady's Hill." It received its name from an interesting border adventure, which occurred in "early times," near its base. Captain Samuel Brady was one of that band of brave men, who lived, in the trying days of the American Revolution, on the western borders, exposed to all the horrors and dangers of Indian warfare, and whose names should be perpetuated in history. He held a commission under the United States, and for a part of that time commanded a company of rangers, who traversed the forests, for the protection of the frontiers. He was born in Shippensburgh, (Pa.) in the year 1758, and removed probably when a boy, into the valley of the Monongahela.

At the period of this adventure he lived on Chartier Creek, about twelve miles below Fort Pitt; a stream better known, however, to the pilots and keel-boatmen of modern days, by the significant name of "*Shirtee.*" He died in 1796, soon after the close of the Indian war. A number of articles were published in the "Blairsville Recorder," a year or two since, detailing his adventures, which would make a most interesting volume. His father and a brother were both killed by Indians. I shall have occasion to refer to him again in the course of my visit.

Legend of Brady's Hill.—I received the particulars of the following story from one of the passengers in the coach, who had resided in the country several years, and had often heard it related. Samuel Brady, the hero of the following adventure, was over six feet in height, with light blue eyes, fair skin, and dark hair: he was remarkably strait, an athletic, bold, and vigorous backwoodsman, inured to all the toils and hardships of a frontier life, and had become very obnoxious to the Indians, from his numerous successful attacks on their war parties, and from shooting them in his hunting excursions, whenever they crossed his path, or came within reach of his rifle; for he was personally engaged in more hazardous contests with the savages, than any other man west of the mountains, excepting Daniel Boone. He was in fact "an Indian hater," as many of the early borderers were. This class of men appear to have been more numerous in this region, than in any other portion of the frontiers; and this doubtless arose from the slaughter at Braddock's defeat, and the numerous murders and attacks on defenceless families that for many years followed that disaster. Brady was also a very successful trapper and hunter, and took more beavers than any of the Indians themselves. In one of his adventurous trapping excursions, to the waters of the Beaver River, or Mahoning, which in early days so abounded with the animals of this species, that it took its name from this fact, it so happened that the Indians surprised him in his camp, and took him prisoner. To have shot or tomahawked him on the spot, would have been but a small gratification to that of satiating their revenge by burning him at a slow fire, in presence of all the Indians of their village. He was therefore taken alive to their encampment, on the west bank of the Beaver River, about a mile and a half from its mouth. After the usual exultations and rejoicings at the capture of a noted enemy, and causing him to run the gauntlet, a fire was prepared, near which

Brady was placed, after being stripped naked, and with his arms unbound. Previously to tying him to the stake, a large circle was formed around him, consisting of Indian men, women, and children, dancing and yelling, and uttering all manner of threats and abuse that their small knowledge of the English language could afford. The prisoner looked on these preparations for death, and on his savage foes, with a firm countenance and a steady eye, meeting all their threats with a truly savage fortitude. In the midst of their dancing and rejoicing, a squaw of one of their chiefs came near him with a child in her arms. Quick as thought, and with intuitive prescience, he snatched it from her and threw it into the midst of the flames. Horror-struck at the sudden outrage, the Indians simultaneously rushed to rescue the infant from the fire. In the midst of this confusion, Brady darted from the circle, overturning all that came in his way, and rushed into the adjacent thickets, with the Indians yelling at his heels. He ascended the steep side of the present hill, amidst a shower of bullets, and darting down the opposite declivity, secreted himself in the deep ravines and laurel thickets that abound for several miles to the west of it. His knowledge of the country and wonderful activity, enabled him to elude his enemies, and reach the settlements on the south of the Ohio River, which he crossed by swimming. The hill near whose base this adventure is said to have happened, still goes by his name; and the incident is often referred to by the traveller, as the coach is slowly dragged up its side.

After travelling a few miles, in rather a hilly region, the face of the country gradually becomes more level, and before leaving the state of Pennsylvania, the hills subside into low undulations, but little more elevated than is required to drain the country of the superabundant waters. This formation continues to near the shore of Lake Erie, and embraces what is called the *Connecticut Reserve.* In it are seated many flourishing villages, and a most industrious and thriving population. The soil is generally better adapted to grass and meadows, than to the cultivation of grain. Accordingly, large stocks of cattle and extensive dairies are kept. Cheese and butter are staple commodities. For profitable management, from fifty to one hundred cows are considered sufficient for one farm. A market is found for the fat cattle and the productions of the dairy, at Cleaveland and Pittsburgh; the canals giving them the advantage of both the New York and Philadelphia marts, for the sale of their

produce. With these advantages, the price of lands has more than doubled since the opening of the canals, and will double again when the Ohio and Pennsylvania Canal, down the Mahoning and Beaver, is finished. For these advantages, the inhabitants of the present day may thank a few wise and patriotic men, the projectors of "internal improvement," which but for these men, would not have been accomplished until the succeeding age. Directly after passing the state line between Pennsylvania and Ohio, we cross a corner of the county of Columbiana. This boundary was established in the year 1802, and runs a north course, on a line 3° 32′ west of Washington, from the mouth of Yellow Creek on the Ohio River, to Lake Erie. We arrived at Poland at 8 P. M., where I left the stage.

Poland, May 9.—Poland is a flourishing village, seated on the waters of the Mahoning,* in the S. E. corner of Trumbull County. It contains a number of stores and mills, and from its proximity to the Ohio and Pennsylvania Canal, will soon be a town of considerable importance. The cherry and peach are here just opening their blossoms, and the forest trees are yet quite naked of verdure. Vegetation at the mouth of the Muskingum, is at least ten days earlier than it is here, which is caused partly by the difference in latitude, and partly by elevation of surface. It is a singular fact, that the peach tree is filling with blossoms, from the mouth of the Beaver on the Ohio, to the shores of Lake Erie, while at Marietta, and generally on the river for many miles above and below that place, the winter has destroyed all the embryo fruit buds; and yet here, in a degree of cold far more intense, they escaped. This fact is probably owing to a more hardy growth, in a climate where severe winters are not uncommon, and where they are continued with much more uniformity of temperature. Many tender plants bear severe continued cold, while a less degree destroys them if subjected to repeated thawing and freezing. For this reason, a tender vine on the north side of a building, is more safe than on the south side.

Collection of shells, minerals, &c.—I called this morning on my friend, Dr. Kirtland, with whom I shall spend a few days. He lives on a farm adjoining the village of Poland. Every thing about it is in good taste and under excellent cultivation. He is a lover

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* The definition of Mahoning, according to Mr. Heckenwelder, is as follows: Mahoni, *a lick;* Mahonink, *at the lick.*

of fine fruits, and in person attends to the various operations necessary to the successful growth of all the good fruits that can be raised in this climate. His selection of plums, pears, cherries, peaches and apples, is equal in variety and excellence to any in the western country. The cultivation and study of one branch of natural history, often creates a taste for the rest. Accordingly, my friend has turned his attention to botany, conchology, and mineralogy. His collection of fresh water and land shells is very valuable, embracing nearly all the described species found in the west. They are neatly arranged in cases, and each shell deposited in a movable plaster cell, so that they can be examined separately without soiling or displacing the specimen. His collection of marine shells, minerals, and fossil organic remains, is also very interesting. The value of the fresh water collection is much enhanced, from having been made principally with his own hands, from the rivers and ponds in the northern part of Ohio. This has given him an opportunity to discover the hidden retreats and haunts of the molluscous races, while searching for specimens, and thus he has been enabled to learn a great deal of their natural history and habits. He was the first to discover the distinction of the sexes in these animals, from the difference in the outlines of their shelly coverings, as noticed in the 26th volume of this Journal. Since that time he has continued his observations, by dissections at different periods of gestation, developing the ova in their various stages, and observing the females of various species, in the act of throwing them off *per saltum,* while lying on their sides, in shoal water. By the aid of a lens, they are found to be viviparous, and not oviparous, as was generally believed by naturalists. After exposing the roe, or oviducts, to the rays of the sun, the valves of the young shell separate, and can be distinctly seen with the naked eye. It is thought by Dr. K. that all our Uniones and other bivalve shells are distinguished by sexes, and that he will be enabled in a short time, by dissections of the living animal, and the contour of the shell, to point them out. This discovery will be very important, not only in elucidating many hidden things in the economy of molluscous animals, but also in correcting the nomenclature of American conchology; several shells of the same species being now classed as distinct shells, when in fact they are only the different sexes of the same shell. It is only by patient investigation, conducted by men of leisure and genius, that such discoveries are made;

and in this country, where the accumulation of property so generally absorbs the public mind, few such men are to be found.

May 10*th*, being the Sabbath, was passed as a day of contemplation and rest.

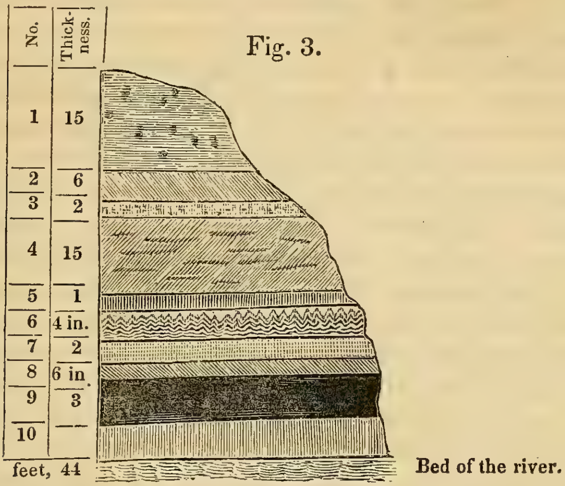
Mahoning Valley, May 11.—Dr. K. and myself visited an interesting locality of fossil vegetable remains, called "Mariner's mills," lying on a small creek discharging into the Mahoning, on the north side of the stream. In going out, we crossed the valley of the Mahoning, up which the Ohio and Pennsylvania Canal will pass, in its progress westward to join the Ohio Canal, and unite the waters of Lake Erie with those of the Delaware. The Mahoning valley or alluvion is about a mile broad, and depressed nearly one hundred feet below the surface of the adjacent country. The soil is very fertile, and finely cultivated. The whole region is gently undulating, and beautifully formed for agricultural purposes, so that in a few years it will be improved like a garden. The present staple productions of Trumbull County, and generally of the "Western Reserve," are those of the dairy, fat beeves and wheat. The soil and climate are both congenial to grazing, and cattle, as large and fine as those from the prairies of the west, are raised here with little trouble. The dairy farms usually support from forty to one hundred cows, and with judicious management are profitable. Traders in produce generally contract with the farmers for their cheese before it is made, stipulating a certain price, to be paid on delivery, generally from six to seven cents per pound, at the door of the dairy, or at some adjacent store. Butter, in quantity, and of the best quality, is sold for eight or nine cents. There is scarcely a waste acre of land on "the Reserve;" nearly all may be cultivated, although some of the low tracts will require draining.

Tertiary Deposits.—The surface of the country, from the Pennsylvania line, north of lat. 41°, appears to be generally an imperfect tertiary formation, resting on the secondary, and is composed of argillaceous earth and decayed vegetable matter. Granite and other primitive bowlders are scattered all over the earth, with pebbles and gravel intermixed to a considerable depth, varying from twenty to thirty or more feet. It is, strictly speaking, neither tertiary or diluvial, but partakes of the characters of both these formations. In the vicinity of Poland, this deposit rests on a bed of blue clay, plastic and tenacious, like that slowly deposited from water when in a state of rest, varying in thickness from six to fifteen feet. The blue clay reposes

on a bed of fine micaceous sand, in which is found permanent water for wells. Above the blue clay, the water is soft and good for washing; that below is impregnated with an acid, and is hard.

The following section of rock strata, (fig. 3.) taken on Yellow creek, a southern branch of the Mahoning, near Poland, will show the order of stratification, including the semi-tertiary deposits, to the bed of the stream. Order descending.

Fig. 3.



1. Semi-tertiary deposits, composed of clay, intermixed with bowlders of primitive rocks, pebbles and gravel.—15 feet.

2. Tenacious blue clay, or plastic clay.—6 feet.

3. Fine, white micaceous sand, with pebbles. In this bed is found permanent water for wells.—2 feet.

4. Light gray, slaty sandstone rock, with some mica. This deposit contains the casts and impressions of many species of fossil plants, of the arborescent ferns, Calamites, &c.—15 feet.

5. Brown shale, filled with kidney-shaped masses of argillaceous iron ore, containing blende and oxide of zinc, in small quantities, with sulphate of magnesia, on the dry surface of the shale, in fine crystals.—1 foot.

6. A stratum of an *apparently crystalline*, calcareous fossil, shooting into pyramidal masses, closely compacted; about four inches in thickness. *Specific character*,—shape, conical; surface marked by numerous undulating, circular striæ; color, light slate; from two to

four inches in length, and from half an inch to one inch in diameter at the base. I can describe the form and structure no better than by saying they resemble a mass of conical "candle extinguishers," one placed within the other, and so arranged as to make a compact bed, four inches thick, and extending over an indefinite space. The thickness of the sides of the cones, varies according to size, from an eighth to a twelfth of an inch. The form resembles some of the species of Belemnites, more than any other fossil. Its geological position, according to Blainville, is favorable to this supposition, being near the tertiary or recent secondary deposits. Its composition is calcareous, effervescing strongly with dilute sulphuric acid, when pulverized and mixed with it. It is not a deposit, but a regularly organized substance, like coral or madrepore, and I have no doubt formed through animal agency. It is also peculiar to the calcareous deposits of the coal series, and I believe found only on the outer margins of the great coal basins, in the valley of the Mississippi, where they approach the tertiary deposits. I have in my cabinet specimens of the same fossil, from the coal region on the Osage River, in the vicinity of Harmony, the missionary station, presented to me by the Rev. Mr. Boynton, who collected them with his own hands from the bed of the river, in place. It is there from four to eight inches in thickness, and is named by the hunters "coal blossom," as where that is seen coal is usually found in the vicinity. When exposed to the air, the fossil separates easily, and can be taken out whole, in the same way that a package of thimbles, or a pile of tin cones, placed one within the other, may be separated. I have the same fossil, but much larger and thicker, from the Gauly River, in western Virginia, found imbedded in bituminous shale, in rolled masses; also, from near Chilicothe, found in excavating the Ohio Canal, resting on gravel, at the depth of eight or ten feet. These last specimens are siliceous, about four inches thick, and were broken from a water-worn mass, a foot across the face, much resembling the transverse section of a log of wood. They were probably brought from the northern borders of the coal deposits, at the same time that the granite bowlders were scattered over the tertiary region of the great valley, and by the same catastrophe. An appropriate name for this organized stratum, might be Belemnita-Madrepora, provided it should, on further examination, be proved to be of the family of Belemnites. Additional aid to this conjecture is found in the fact, that the deposit on which this stratum rests, is

limestone, filled with various species of marine shells, and apparently composed altogether from their broken down fragments. Correct figures of the form and structure of this beautiful fossil, are given in the 29th volume of this Journal, page 14 of the wood cuts, and figure 27.—4 inches.

7. Blue, magnesian limestone, breaking into rhombic fragments; in two beds—upper bed eighteen inches thick; compact, and takes a good polish, similar to bird's-eye marble. Lower bed six inches thick; slaty structure, and filled with shells of the genera Producti, Spiriferi, Ammonites, Encrini, &c. generally contorted and broken; upper portion also filled with shells.—2 feet.

8. The lime-rock reposes on a deposit of blue, argillaceous shale. When first exposed to the air, this deposit is of the consistence, color and *smell* of marsh mud. When dry, it takes the structure of shale. It is filled with larger and more numerous specimens of shells similar to those in the lime-rock above.—6 inches.

9. Bituminous coal and shale, three feet; upper half of the deposit composed of shale, which, on exposure to the air, becomes covered with a thick efflorescence of sulphate of iron and sulphate of magnesia; lower half, tolerably good coal.—3 feet.

10. White or light gray sandstone rock, fine and compact, forming here the bed of the creek. A few miles below, and deeper in the bed, this deposit of sandstone contains a vast collection of fossil tropical plants, of ferns, palms, &c.

Coal Deposits.—The coal deposits begin to grow thin, as we approach the table lands between Lake Erie and the waters which run into the Ohio. Over a large portion of this semi-tertiary or diluvian tract, the *upper deposit* of coal has been torn up and washed away, at the period, and by the same cataclysm which covered this portion of the valley with primitive bowlders and tertiary deposits. It is found yet in place in several eminences, and especially at a spot, two and a half miles S. W. of Poland, on the sides of an elevated tract, where it crops out, and six miles further south passes under a tamarack and cranberry swamp of several miles in extent. This swamp lies about one hundred and fifty feet above the general surface of the country north of it. On the sides of this ascent the coal comes to the surface, and is worked, but not extensively. It is about three feet in thickness, and of that quality peculiar to the upper bed all over the valley of the Ohio, being of a slaty structure and glistening fracture, but when burnt in a grate it melts and runs

together, obstructing the free passage of the air. It is a good species for coaking, and contains a large portion of carbon for a bituminous coal, it being about sixty per cent. About one hundred feet below this, lies the coal bed noted in the foregoing section.

Mounds.—Natural mounds of sand are common in this part of Ohio, evidently thrown up by water, and similar in structure to those noticed by Prof. Hitchcock, as common to the tertiary deposits of the west. I observed one near the village of Poland, about fifteen feet in height, and from forty to fifty feet in diameter, so completely isolated, and of a form so perfectly resembling the barrows of the ancient inhabitants, that many believe it to be artificial. It is found by the neighboring inhabitants to be a useful depository of sand for the manufacture of mortar, &c.

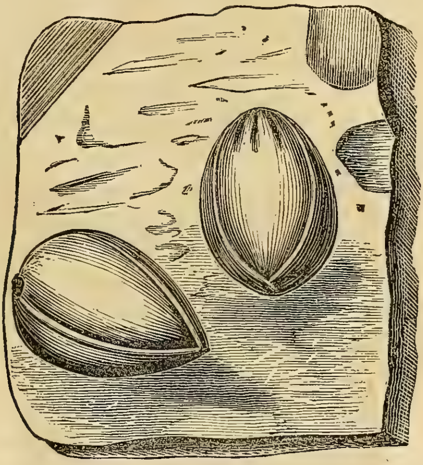
Siliceous Conglomerate.—Amongst the numerous bowlders of this region, I observed several of siliceous conglomerate, similar in structure to the rock found in the Laurel and Alleghany Mountains, and used in the manufacture of mill stones. In Geauga County, forty miles north, it is found in place, and continues on nearly to Lake Erie. It is associated with similar deposits, and is without doubt a continuation of the same rock with that found in the mountain ranges, on the south side of the valley of the Ohio. Some of the bowlders are very large, sufficient to make a pair or two of mill stones.

Fossil Plants.—On examining the impressions and casts of fossil plants obtained at Mariner's Mill, I found them to embrace several species of Palm, Calamites, Sigillaria, &c., several of them entirely new to me, and eminently beautiful. They are so perfect that Mr. Mariner, a plain farmer, kept them a number of years to show to his neighbors as curiosities. He found them in opening a quarry by the side of the stream, for the erection of a mill dam. A little lower down in the same rock, opened this spring, are found very perfect specimens of a new species of Carpolithus. They are very abundant, and are imbedded amidst fragments and impressions of various coal plants. We obtained about a dozen specimens, some of which are very fine, and will be described with a few other interesting casts found here. The rock is a light gray sandstone, similar to that described as lying at the base of the foregoing section in the bed of Yellow Creek, and is a continuation of the same deposit.

Carpolithus trilocularis.* *Specific character and description.*—An oblong, ovate nut, divided longitudinally into three equal divisions, by strongly marked, elevated ridges, running from the base to the tip; base truncated, and profoundly impressed with the cicatrix of the stem; tip rather pointed; surface smooth; length one inch and four lines; diameter ten lines.

Observations.—Some of the specimens are flattened, others retain their original rotundity; found in the sand rock at Mariner's Mills, intermixed with casts of various species of plants; amongst which were Sigillaria, Calamites columnare, Calamites dubia, with several species of arborescent ferns. This nut is probably the fruit of some antediluvian Palm. We obtained a number of specimens, several of which were detached from the rock, while we were present. Drawings of two specimens are given at fig. 4.

Fig. 4.



Syringodendron Kirtlandius. *Specific Character.*—Stem swelled at intervals; surface finely striated, and covered with alternate grooves and double linear dot-like impressions, arranged longitudinally.

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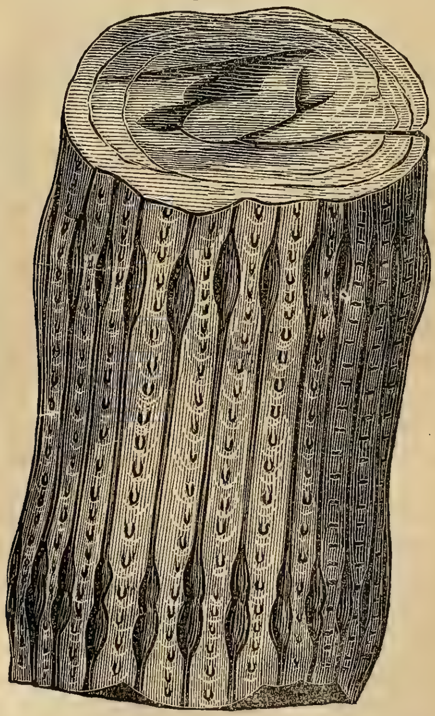
* On examining the shell of the recent cocoa nut, I find its surface marked with prominent ridges, dividing the disk into three equal divisions, similar to the Carpolithus trilocularis. This fact is an additional proof of these fossil nuts being the fruit of some ancient Palm tree.

Description.—Stem arborescent; length unknown; cylindrical; surface finely striated, longitudinally, and ornamented with double rows of dot-like, linear impressions, divided by obsolete grooves, which at intervals of two inches are profoundly widened and deepened, while the interstitial spaces containing the dot-like impressions are raised into narrow ridges, giving the stem the appearance of being jointed; dot-like impressions arranged in quincunx; stem two inches and a quarter in diameter.

Observations.—Found in the sandstone rocks at Mariner's Mills, in Trumbull County, Ohio. It is a fragment of a stem, which from its thickness must have been several feet in length. The markings on the surface are amongst the most delicate and beautiful I have ever seen. In the belief that it will prove to be a new species, it is dedicated to my friend Dr. K. (Fig. 5.)

Fig. 5.



Sigillaria Marineria. *Specific Character and Description.* Stem channeled; impressions in form of disks, arranged in quin-

cunx; grooves half an inch in width, two-eighths deep; disks nearly filling the width of the groove, a little raised, and depressed at one side; distance equal to the diameter of the disks.

Observations.—A most beautiful and perfect impression, about fifteen inches in length; the original trunk, of which this is only a segment, must have been more than a foot in diameter, and many feet in length. In fine grained sandstone, at Mariner's Mills, and named for that locality. I received also a beautiful cast of Calamites columnare, remarkable for the size and depth of the columns, from Dr. K., finely impressed in red sandstone, from a locality some miles north of this spot. (Fig. 6.)

Fig. 6.

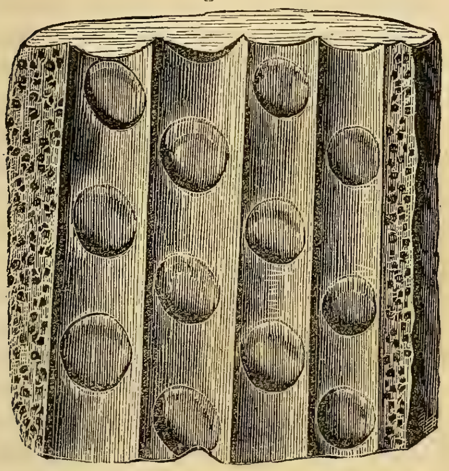
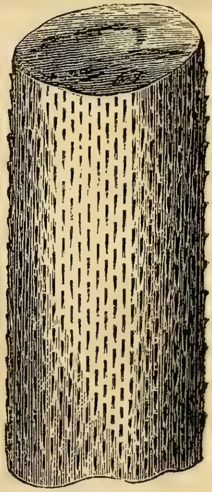


Fig. 7.



Half size.

Ficoidites scabrosus. *Specific Character and Description.*—Cicatrices approximate; arranged spirally; spines small, stem cylindrical; one inch and a half in diameter, up to four inches; length unknown.

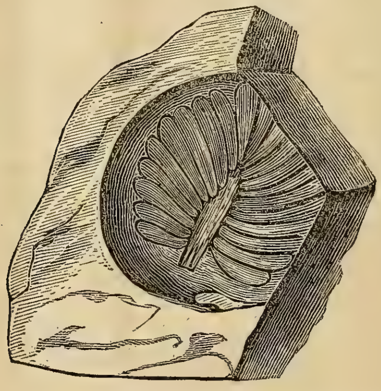
Observations.—When taken from the sandstone rock on the Mahoning River, the surface was coated with bituminous matter. This fossil plant much resembles some of the recent species of Cactus, and was probably of the same succulent growth, and coated with spines. I have several specimens of various sizes, from half an inch to four inches in diameter. They are all sandstone casts. Same locality. (Fig. 7.)

STROBILUS CARYOPHYLLUS. *Specific Character.*—Cone-shaped; seeds radiating from an oblong centre; stem thick and short.

Description.—Capsule cone-shaped, nearly round; fruit arranged in radii; oblong, clove-shaped; half an inch in length, and one line in diameter. Strobilus, one inch in diameter.

Observations.—The fossil above described is apparently the fruit of some cone-bearing tree. The seeds are arranged like those of the Plane tree, but are twice as large, and not half as numerous. They are more clove-shaped, and not flat like those of Coniferæ or resinous trees. It is probably the fruit of some extinct species, buried amidst the ruins of the coal strata at that period when arborescent ferns clothed this part of the earth. From the sandstone rocks on the Mahoning River. (Fig. 8.)

Fig. 8.



Massasauga, Rattle Snake.—In the Tamarack and Cranberry swamp, noticed as lying over the upper coal deposit, are found large numbers of a small black, or very dark brown rattle snake, about twelve or fourteen inches in length, and of a proportionate thickness. They have usually three or four small rattles. This species seems to be confined to the Tamarack swamps, and are found no where else but in their vicinities, wandering in the summer months a short distance only from their borders. When lying basking in the sun, they resemble a short, dirty, broken stick or twig, being generally discolored with mud, over which they are frequently moving. Their bite is not very venomous, yet they are much dreaded by the neighboring people. Their habitations are retired and unfrequented, so that few persons are ever bitten. The Indian name for this snake

is Massasauga. It is probably the species known to naturalists as the Crotalus miliarius, although from the early period of the season I had not an opportunity of seeing one. The large rattle snake, or Crotalus horridus, appears to be nearly extinct in this part of Ohio.

Roads.—May 12th: Left Poland this morning, in company with Dr. K. for the Falls of the Cuyahoga, distant about fifty eight miles. The main road here takes a due east and west course, and runs in this direction, with little variation, for one hundred and sixty miles: and for one hundred and twenty of this distance it passes through the centre of the southern range of townships in "the Reserve." This is probably the longest road pursuing an undeviating course in the United States. The townships or towns, as they are here called, are all five miles square, and it is the undeviating practice to run the roads on right lines from east to west, and from north to south. One passes through the centre of every township in these directions, and one on the line between each township, with minor roads at intervals of one mile and a quarter, for the convenient intercourse of the inhabitants. Few countries will admit this beautiful arrangement, but here the surface is so level, or only occasionally diversified with a broad but moderate elevation, that a road may be run in any direction.

Villages.—In the centre of each town where the roads cross, is usually a small village, made up of one or more churches or meeting houses,* the school house, one or two stores, a tavern, smith's shop, with a number of neat private dwellings, including those of the lawyer and physician. Many of these villages are finely situated, and the buildings being generally of wood, painted white, make a very neat appearance, in contrast with the rich green of the meadows, and the foliage of the trees. We passed through several such in the course of the day, and among them the village of Canfield is eminently beautiful. From a number of low hills we had an extensive view of the adjacent country, embracing a horizon of ten or twelve miles, and bringing at once under the eye the spires and whitened walls of four or five distant villages. At the period of the first settlement of this portion of Ohio, in the year 1798, the soil was very wet over many extensive tracts, which it was feared would never be fit for cultivation; but as the forests are opened, and the rays of the sun and the winds admitted, the soil becomes sufficiently

* A name derived from the Puritans of New England, because in Britain at the period of their emigration, no houses for public worship were called churches, except those of the establishment; the rest were houses for meeting or meeting houses.

dry for all the purposes of agriculture, and the roads which were once all mire are now firm and hard.

Fruit Trees.—Fruit trees flourish luxuriantly, and are rarely rendered barren by untimely frosts. Almost every farm is provided with an orchard, it being a prime object with the first settlers to plant out fruit trees as early as possible; and in my journey to-day, at every new opening, I observed a small collection of apple and other fruit trees, on the first half acre cleared near the house. This rich region has lately become still more valuable from the contemplated canal down the valley of the Mahoning to Beaver. The inhabitants are generally from the State of Connecticut, and display all that neatness in their buildings and in the cultivation of the soil, which distinguish that enterprizing people.

Original Patent.—Under the patent of the Saybrook Colony, granted by Charles the First, in the year 1631, the territory of Connecticut extended westerly across the continent to the South Sea or Pacific Ocean. The patents of Virginia and the Carolinas had also the same westerly extension. On the strength of these patents, when the general compact of all the States was formed, the right of Connecticut was acknowledged with the rest; and that right was commuted by the grant of a certain tract, bounded east by Pennsylvania, on the south and north by the Ohio River and Lake Erie, and extending west on the forty first degree of north latitude one hundred and twenty miles; embracing about three millions, eight hundred thousand acres,* and at present divided into eight counties, with a population of 150,000: after setting off half a million of acres from the west end of this tract, for the benefit of the sufferers by fire in New London and other places, the State of Connecticut sold the remainder to individuals on a credit of years: the proceeds are appropriated to the perpetual support of common schools in that State.†

Sulphate of Lime.—About noon I visited an interesting locality of the sulphate of lime. It is found crystallized, and diffused through a deposit of calcareous earth. The crystals are tabular, and are sometimes large and very fine. It is on Meander Creek, a branch of the Mahoning, near the western border of the town of Canfield. Below this deposit, is a stratum of bituminous shale, containing the imbedded relics, and casts of many fossil plants and shells. Some of the plants resemble long feathers, and are probably

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* This tract, being *reserved*, was called *The Reserve*, and is so named in this diary.

† Now constituting a productive fund of nearly 2,000,000 of dollars for a population of 300,000.

the foliage of an antediluvian Palm tree. The figure of a portion of one is given at Fig. 9. Some of these plumose fragments can be traced for more than a foot between the layers of shale.

Fig. 9.

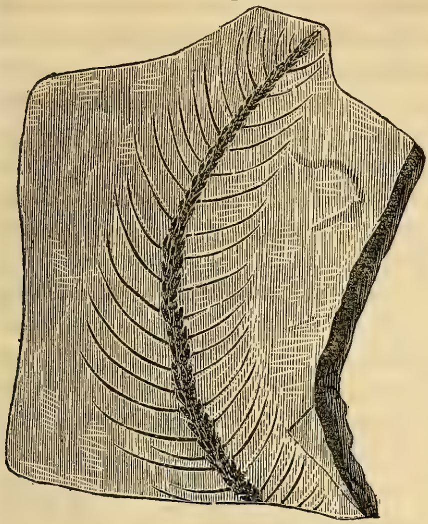
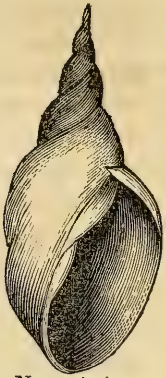


Fig. 10.



Natural size.

Ponds.—Shells.—After leaving Trumbull, we enter Portage County. In this county we found a number of beautiful ponds, from each one of which flows a perennial stream. One, which lies a few miles south of our route, in Stark County, called "Congress Lake," was, until recently, the only known locality of the fine univalve shell, *Lymnæa stagnalis.* It was discovered by Dr. K. in the course of the last season. I have one in my possession, which is two inches in length, with the body whorl three fourths of an inch in diameter. As this rare and elegant shell has not been figured or described by any American conchologist, a drawing is given at Fig. 10. The description is copied from Dillwyn, and appears to be so similar to that of our own shell, that there can be no doubt of its identity with the European species, although it is a rare fact, and which scarcely again occurs in all our long list of land and fresh water shells. Geoffroy calls it "Le grand Buccin."

Lymnæa stagnalis. (Lamarck.)—*Specific Character.*—"Shell imperfect, oblong, ventricose, pellucid, with the spire produced and subulate; aperture ovate."

Description.—"Shell often two inches long, and about half as broad, thin, brittle and pellucid, of a whitish, dusky, or grayish color;

sometimes covered with a greenish epidermis. It has six or seven whorls, of which the body whorl is very large, and constitutes half the length of the shell."

This whole region abounds with fine Helices, for which family the moist woodlands afford suitable habitats. The following catalogue of *univalve* shells, found on "the Reserve," is from the pen of Dr. K., the whole of which are in his collection:

Pupa	exigua,	Say.	
"	orata,	"	
Helix	albolabris,	"	
"	thyroidus,	"	
"	hirsuta,	"	
"	perspectiva,	"	
"	lineata,	"	
"	labyrinthica,	"	
"	multilineata,	"	
"	palliata,	"	
"	gularis,	"	
"	ligera,	"	
"	solitaria,	"	
"	concava,	"	
"	profunda,	"	
"	alternata,	"	
"	egena,	"	
"	fallax,	"	
"	tridentata,	"	
"	harpa,	"	*
"	glaphyra,	"	†
"	inornata,	"	†
Helix	fuliginosa,	Grif.	†
"	pennsylvanica,	Green.	
Succinea	ovalis,	Say.	
"	avara,	"	
"	obliqua,	"	
Melania	depygis,	"	
"	virginica,	"	‡
"	subularis,	Lea.	
Lymnæa	elodes,	Say.	
"	reflexa,	"	
"	macrostoma,	"	
"	desidiosa,	"	
"	stagnalis,	Lam.	§
Physa	heterostropha,	Say.	
Paludina	ponderosa,	"	
"	decisa,	"	
"	granosa,	"	
Planorbis	bicarinatus,	"	
"	trivolvis,	"	
"	campanulatus,	"	
"	armiger,	"	
"	exacuus,	"	

* "H. harpa.—I was suspicious from the description and figure of this shell in the 2d Vol. of Long's Expedition to the St. Peter's, that Mr. Say had described an immature shell of some large species of Pupa. On examining his specimen, deposited in the Academy of Natural Sciences at Philadelphia, I am convinced that such was the fact. Both the Pupa ovata and arrifera, just before they form the perfect mouth, answer Mr. Say's description and figure above referred to."

† "Helix glaphyra and inornata of Say, and H. fuliginosa of Griffith, are only different ages of the same shell, if the specimens which I have received from the Philadelphia conchologists be labelled correctly. When the shell is young, the umbilicus is contracted, and the labrum not expanded. It then is called the *glaphyra*. At a more advanced age, the labrum expands and forms a large aperture, but the umbilicus still remains unchanged, and at this stage it is the *inornata*. An

Bivalve Shells.—The bivalve shells are equally prolific in species, and afford thirty four of the genus Unio, four of Alasmodonta, and five of Anodonta. The Unio nasutus, hitherto considered exclusively an eastern shell, is abundant in the streams that enter into Lake Erie.

Portage County.—Portage County embraces much fine land for tillage, and also for meadows. It is descriptively named from the fact of its containing within its limits the old Indian portage between the waters of Lake Erie and the Muskingum River. In the south western part of the county is a tract of several miles in width, and running in a S. W. and N. E. direction, of a peculiar formation. The surface is studded with numerous small hillocks, composed of gravel and sand. In the depressed portions between the hills, are scattered a number of beautiful ponds of fine transparent water, containing fish peculiar to this region, especially the black bass. Spotted perch, sun-fish, &c., are also common, with a black catfish or horn pout, similar to that found in the ponds east of the mountains. This species of the genus Silurus I have not seen in the Ohio river. They also contain the Nelumbium luteum and fragrant Nymphæa. Some of them are of great depth, and said to be based on quicksands. At their outlets they are generally more or less swampy, but the shores are lined with a fine white sand. The surplus waters of many of these small lakes are discharged into the Cuyahoga, and from thence into Lake Erie, proving them to be seated on some of the highest land between the Muskingum and the lake. Many of them are beautiful sheets of water of four or five hundred acres, and from their resemblance to the small crystal lakes of New England, recalled many delightful recollections of my early years in my native land.* They were the first I had seen in thirty years, or since I crossed the Alleghany Mountains, as they are confined to the table lands between the lakes and the Ohio River, which I had not before visited. These calm and quiet lakes, once the home of the

additional volution, added in such a manner as to form suddenly a large umbilicus, makes the *fuliginosa.*"

‡ "M. virginica.—It is probable that two or three species existing in the waters in Ohio, are included under this name; and it is doubtful whether either is specifically identical with the eastern shell described by Mr. Say."

§ "Lymnæa stagnalis.—A few fine specimens have been found in the Congress Lake, and in some other small lakes in this section of country. I have also received some from Dr. Foote of the U. S. Army, collected in Lake Winnebago. They are exact analogues of the European shells of this name."

* Massachusetts.

half reasoning beaver, seem to have been placed on these elevated table lands for the very purpose to which they will shortly be applied, that is, as reservoirs for the supply of a canal.

Agricultural Products.—May 13: After leaving the town of Atwater, we pass over the same kind of low, undulating, diluvial deposits, that we met with in our yesterday's journey. The soil will every where admit of cultivation, and produces fine crops of grass, grain, and potatoes. Some low spots will need a few ditches, but generally, where the forests are removed, the earth becomes sufficiently dry for all the purposes of agriculture, and for good permanent roads.

Climate.—This change in the surface must ultimately have a very marked influence on the streams of water, rendering them very low and dry in the summer, and more subject to floods in the winter. It will also influence the seasons. As the forests are removed, evaporation becomes more rapid, the heat of summer more intense, and rains more rare. Extremes of temperature will be greater. Trees not only exclude the rays of the sun, and prevent evaporation from the surface, but, by the radiation of heat from their leaves, they depress the temperature, and thus condense the moisture of the atmosphere, and in a level country supply the place of mountains, in calling down humidity from the clouds. Thus, they preserve a more equable temperature in the various seasons, diminishing the heat of summer and mitigating the cold of winter. It is probably from this cause that our winters are said to be more severe, than they were in the first settlement of the country. We have a practical illustration of this theory in the climate of Missouri and Illinois, where the immense prairies are visited by a degree of cold many degrees below that of the same parallel in Ohio, and where droughts are much more common. The vicinity of a great fresh water sea, like that of Lake Erie, will be some alleviation to the latter difficulty in this state. The average crops of hay, in this county, are two tons to the acre; of oats, from thirty to forty bushels; wheat, about twenty bushels; and potatoes, three hundred. Indian corn succeeds very well on the chestnut and yellow oak lands, but is not so certain a crop as it is a few miles south and west of "the Reserve." Fruit trees flourish well, and while the peach is often destroyed on the border of the Ohio River by frost, here, at an elevation of five hundred feet greater, and a degree and a half further north, the trees are filled with blossoms. It is literally "the land of milk and honey,"

for in addition to the other fruits, the plum and the cherry flourish and bear fruit in the greatest perfection; especially green and yellow gages, and the different varieties of heart and bigarou cherries; while with us, the little curculio, that blaster of the gardener's hopes, will not allow us a single plum. The farms in this quarter, generally contain only one hundred or one hundred and sixty acres; some, however, are larger; and they are almost invariably furnished with a well built comfortable frame house, and suitable barn and out-houses.

Poor-houses.—As a mark of the general thrifty and comfortable condition of the inhabitants, it may be stated as a fact, that few, if any, of the counties, have need of a *poor-house.* I was told, that more than half of the townships do not assess any poor tax, and in those which do, the sum is very small. The true cause of this exemption from *poor rates,* the bane of many a fertile portion of the earth, may be found in the industrious, frugal habits of the people, who have generally come from that "land of steady habits," which has furnished more inhabitants, and more able and enterprizing pioneers to the West, than any other state in the Union. I consider "the Reserve" as the most valuable portion of Ohio, and look forward to the day as not very distant, when this whole region will be cultivated like a garden, teeming with a million of inhabitants, and studded with towns and villages.

After leaving the township of Atwater, we entered Randolph, five miles west. Like the centre of all the other townships, this also has a small village of neatly built, white frame houses, with the Congregational church in the midst, forming the most conspicuous feature, and this is characteristic of the towns on "the Reserve." The little red school houses, so common in Connecticut have found their way here, and are seen, at short intervals, along the road, where the population is dense. These, with the temperance societies and Sunday schools, will doubtless preserve the rising and future generations, in the sober, industrious habits of their forefathers. At Randolph we turned off to the north, passing through a tract of country, rather more undulating than that which we traversed yesterday, but every acre of it is fit for tillage. There are a few "Tamarack swamps," but these by draining make the finest of meadows.

Botany.—The Tamarack, Larix Americana, or Larch, is a deciduous tree, although its present, and summer aspect, is altogether that of an evergreen, and it is generally considered so, being, like the pine, a cone-bearing tree. These swamps contain many plants and

shrubs found in the northern and eastern states; such as the Sarracenia or side-saddle plant, Andromeda meniantha or buck-bean, Drosera or dew plant, Coptis trifolia or golden thread; with the white birch or Betula populifolia, and Betula lutea, in the more elevated swamps; and with many others peculiar to these localities, and not found in the southern portion of Ohio. The blueberry, or Vaccinium frondosum, is also a native here; with an abundance of cranberries, Oxycoccus macrocarpus. This whole region is rich in botanical specimens, and appears to be one in which the plants of various and remote portions of the United States are assembled; the great variety of local circumstances and soil, affording congenial habitats to a larger number of species, than any other portion of the valley. It is a fertile field for the labors of the botanist.

Ravenna.—After visiting two or three ponds that lie near our route, in search of Lymnææ and Planorbi, at 1 P. M. we reached Ravenna, the county town for Portage. This beautiful town lies on a broad and moderately elevated tract, commanding an extensive view of the surrounding country. The court house is a large brick building, painted of a straw color, and constructed with much neatness and good taste. Its interior arrangement is very convenient, more so than that of any one I have seen in Ohio. The streets are wide, and the private dwellings are generally substantial and neat in their external appearance. The present number of inhabitants is about eight hundred. The location is directly on the dividing line between the waters which run into the Ohio, and those which run into Lake Erie. The old court house was so situated, that the rain which fell on the north side of the roof passed into the Cuyahoga, and was discharged into the Gulf of St. Lawrence; while that which fell on the south side passed into the Mahoning, and was finally poured into the Gulf of Mexico. The summit level of the new, or Pennsylvania and Ohio Canal, lies about half a mile to the south east of the village. The whole distance of deep cutting will be sixty six chains, and averaging in depth about eighteen feet below the natural surface.

Ohio and Pennsylvania Canal.—The length of the line of this canal, as reported by Col. Kearney of the U. S. Topographical Engineers, is as follows:

From Akron, Portage summit of the Ohio Canal, to the Ravenna summit, - - - - -	25 miles.
From Ravenna summit to Chenango River, -	67 "
Total length of canal, - - -	92 "

Total amount of ascent, from the Portage summit to the Ravenna summit, is one hundred and seven feet; total descent, from Ravenna to Chenango, is three hundred feet; amount of lockage, four hundred and seven feet. The breadth of the canal at bottom is twenty five feet; at the surface of the water, forty feet; depth of water, four feet.

"Of the commercial importance of this canal, when finished," the Commissioners say, "no doubt can be entertained, by those who understand the interest and geography of our country. The route passes through one of the best settled and most wealthy districts of our state, and when executed, it will, together with the Ohio Canal, open a direct and convenient channel of commerce between the interior of Ohio and the great manufacturing and commercial city of Pittsburgh, together with the whole of Pennsylvania. Between those sections of country an extensive and highly beneficial commerce now exists, which must increase with the growing population of our country, and with the development of its resources. It is, however, only by looking forward to the time when the great Pennsylvania Canal, and the Chesapeake and Ohio Canal, shall have connected the Chesapeake with the Ohio River, the Potomac, and the Delaware, that the importance of the Pennsylvania and Ohio Canal can be duly appreciated. When these great works are completed, the farmer in the center of our state, may put the productions of his fields on board of a boat, which will convey them to Washington, Alexandria, Baltimore, or Philadelphia, without unloading or reshipping; and the merchant may bring his goods from either of those cities to his own door, without risk or change in the method of transportation, and at an expense not exceeding one third of the present cost."

"The profit of this work to the proprietors, must be commensurate to its commercial importance; and it is believed to offer one of the best opportunities for a profitable investment of capital, that can be found in the United States."

The estimated cost of this canal is about one million of dollars. Departing from its usually wise policy, the state of Ohio has suffered the stock of this canal to pass into the hands of a private company. It is owned in Philadelphia, Pittsburgh, and Ohio, as a portion of it lies in the state of Pennsylvania, from the Ohio line to its junction with the canal on the Beaver, at the mouth of the Chenango Creek. This company was incorporated in January, 1827, by the name of "the Pennsylvania and Ohio Canal Company," but the books of

the company were not opened until the spring of the year 1835. The stock was immediately taken up, and the canal must be completed, on or before the month of April, 1837, or the charter will be forfeited. There is no doubt, however, of its completion within the time specified. The prospect of the immense profits it will yield to the stockholders, and the great advantages to the country, will insure its accomplishment. The following may be enumerated as a part only of its good features. It shortens the distance to an eastern market, from the central parts of Ohio, nearly two hundred and fifty miles. It is accessible four weeks earlier in the spring, and two weeks later in autumn, than the route by Lake Erie, or the northern route, which will be of vast importance to the farmer and merchant. It is subject to no dangers or delays from storms or head winds, and calls for no expense of insurance on goods. It will also be a feasible route for merchandise going below the mouth of the Scioto, at those periods when the water in the Ohio is too low for safe steam navigation, as it almost invariably is for several weeks in the summer and autumn. With all these advantages, the opening of the Mahoning Canal will be the commencement of a new era, in the agricultural and commercial history of "the Reserve."

Semi-tertiary deposits.—After leaving Ravenna, our course was directly west, and we soon came on to a region whose geological appearance was quite different from that of the country we had left. East of this line, the soil and surface of the ground are argillaceous. A mile west of Ravenna, the superstratum is a mixture of sand and gravel, with a more numerous distribution of bowlders, although they are seen every few rods over the clayey portions of the country. From Ravenna to the Cuyahoga Falls, the surface is more hilly, but never so much so as to occasion any impediment to tillage. Beautiful sheets of water, or small lakes, are scattered over this formation, at intervals of a few miles, through its whole extent, being a space not less than twelve or fifteen miles in width, by forty or fifty in length, stretching in a N. E. and S. W. direction, from Geauga County, across Portage, into Stark County, and terminating at the sandstone and coal formations. These lakes seem to have been placed here, in this elevated portion of Ohio, as reservoirs for canals and other useful purposes, by him who originally created the earth, and, by the operation of his physical laws, gradually formed it for the residence of man.

Brady's Pond.—In the course of this afternoon, we passed near several small lakes, from half to three fourths of a mile long, and

nearly as wide; being embosomed among low green hills, they resembled beautiful pearls, surrounded by emeralds. Their shores, except at the outlets, are composed of a very white micaceous sand, which gives the water a pure pellucid cast. One of these, called "Brady's Pond," is seated about three miles from the cliffs, or the narrows of the Cuyahoga. It is named after Capt. Samuel Brady, who, as already stated, commanded for a number of years, during the Indian wars, a company of rangers, or spies, as they were called by the pioneers of the West.

Legend of Samuel Brady.—Capt. Brady seems to have been as much the Daniel Boone of the north east part of the valley of the Ohio, as the other was of the south west, and the country is equally full of traditionary legends of his hardy adventures and hair-breadth escapes, although he has lacked a FLINT to chronicle his fame, and to transmit it to posterity in the glowing and beautiful language of that distinguished annalist of the West. From undoubted authority, it seems the following incident actually transpired in this vicinity. Brady's residence was on Chartier's Creek on the south side of the Ohio, as before noted in this diary; and being a man of herculean strength, activity, and courage, he was generally selected as the leader of the hardy borderers in all their incursions into the Indian territory north of the river. On this occasion, which was about the year 1780, a large party of warriors from the falls of the Cuyahoga and the adjacent country, had made an inroad on the south side of the Ohio River, in the lower part of what is now Washington County, but which was then known as the settlement of "Catfish Camp," after an old Indian of that name who lived there when the whites first came into the country on the Monongahela River. This party had murdered several families, and with the "plunder" had recrossed the Ohio before effectual pursuit could be made. By Brady a party was directly summoned, of his chosen followers, who hastened on after them, but the Indians having one or two days the start, he could not overtake them in time to arrest their return to their villages. Near the spot where the town of Ravenna now stands, the Indians separated into two parties, one of which went to the north, and the other west, to the falls of the Cuyahoga. Brady's men also divided; a part pursued the northern trail, and a part went with their commander to the Indian village, lying on the river in the present township of Northampton in Portage County. Although Brady made his approaches with the utmost caution,

the Indians, expecting a pursuit, were on the look-out, and ready to receive him, with numbers four fold to those of Brady's party, whose only safety was in a hasty retreat, which, from the ardor of the pursuit, soon became a perfect flight. Brady directed his men to separate, and each one to take care of himself; but the Indians knowing Brady, and having a most inveterate hatred and dread of him, from the numerous chastisements which he had inflicted upon them, left all the others, and with united strength pursued him alone. The Cuyahoga here makes a wide bend to the south, including a large tract of several miles of surface, in the form of a peninsula: within this tract the pursuit was hotly contested. The Indians, by extending their line to the right and left, forced him on to the bank of the stream. Having, in peaceable times, often hunted over this ground with the Indians, and knowing every turn of the Cuyahoga as familiarly as the villager knows the streets of his own hamlet, Brady directed his course to the river, at a spot where the whole stream is compressed, by the rocky cliffs, into a narrow channel of only twenty two feet across the top of the chasm, although it is considerably wider beneath, near the water, and in height more than twice that number of feet above the current. Through this pass, the water rushes like a race horse, chafing and roaring at the confinement of its current by the rocky channel, while, a short distance above, the stream is at least fifty yards wide. As he approached the chasm, Brady, knowing that life or death was in the effort, concentrated his mighty powers, and leaped the stream at a single bound. It so happened, that, in the opposite cliff, the leap was favored by a low place, into which he dropped, and grasping the bushes, he thus helped himself to ascend to the top of the cliff. The Indians, for a few moments, were lost in wonder and admiration, and before they had recovered their recollection, he was half way up the side of the opposite hill, but still within reach of their rifles. They could easily have shot him at any moment before, but being bent on taking him alive, for torture, and to glut their long delayed revenge, they forbore the use of the rifle; but now seeing him likely to escape, they all fired upon him: one bullet wounded him severely in the hip, but not so badly as to prevent his progress. The Indians having to make a considerable circuit before they could cross the stream, Brady advanced a good distance ahead. His limb was growing stiff from the wound, and as the Indians gained on him, he made for the pond which now bears his name, and plunging in, swam under water a considerable distance, and came up under the trunk of a large oak,

which had fallen into the pond. This, although leaving only a small breathing place to support life, still completely sheltered him from their sight. The Indians, tracing him by the blood to the water, made diligent search all round the pond, but finding no signs of his exit, finally came to the conclusion that he had sunk and was drowned. As they were at one time standing on the very tree, beneath which he was concealed,—Brady, understanding their language, was very glad to hear the result of their deliberations, and after they had gone, weary, lame and hungry, he made good his retreat to his own home. His followers also all returned in safety. The chasm across which he leaped is in sight of the bridge where we crossed the Cuyahoga, and is known in all that region by the name of "*Brady's Leap.*"

*Falls of the Cuyahoga.**—We reached the Cuyahoga Falls Village, at 6, P. M., passing, in the last three miles, through several flourishing villages, seated along the borders of the stream. They are all engaged in manufactures, and several, which three years ago, consisted of only one or two dwelling houses, now number several hundred inhabitants. The Cuyahoga has a fall of more than two hundred feet in the distance of two and a half miles, across stratified rocks, which are worn away to nearly this depth in the course of the descent. The adjacent country, which is moderately hilly, descends with an easy slope on each side of the stream, for a considerable distance down to the cliffs which form the banks of the river, and which is not apparent until you approach near to it. The situation is one of the finest I have seen for a manufacturing town, and is destined, at no distant day, to become to the West, what Lowell is to the East.

Granite bowlders were common every few rods all this afternoon, and two miles north of the village we travelled over the conglomerate rock, in place, noticed in the diary of the 11th.

May 14*th.*—The day was spent in examining the Cuyahoga Falls in company with Mr. Newberry, the very intelligent owner of a large tract of land, embracing the upper half of this valuable site, and who afforded me great assistance in taking a section of the order of stratification. I was much gratified in finding the same rock formations on the northern verge of the great coal basin of the Valley of the Ohio, that are found in its southeastern and southern termination. No appearance of these rocks is discovered near the surface,

* The aboriginal names of streams are almost universally significant and appropriate: the English of Cuyaho is *crooked*, or "the crooked river."

in the valley occupying the intermediate space, as they are buried deep under the coal series, fragments of which are brought up from great depths in boring for salt water, on the Muskingum and Ohio, near the centre of the valley; leading us to infer that the same force from below, which raised the mountain ranges, also raised up the table lands between Lake Erie and the waters which run into the Ohio.

The following section (Fig. 11.) will show the order of stratification from the surface of the highest land in the vicinity of the falls,

Fig. 11.

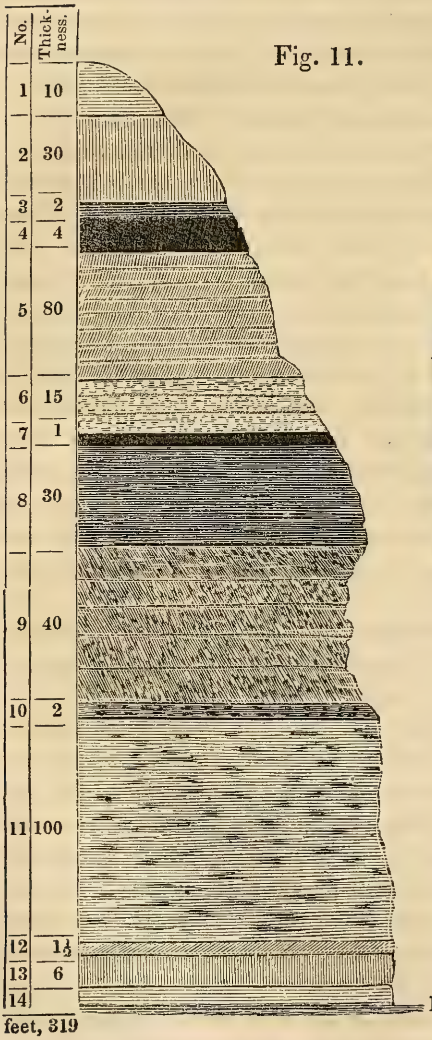
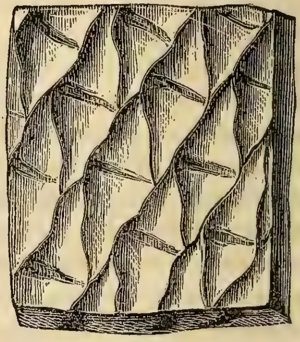


Fig. 12.



over Mr. Newberry's coal mines, to the bed of the Cuyahoga River, about midway of the length of the falls: below this point I did not examine the geology, it being sufficient to elucidate and confirm the object of my visit, viz., the equivalent formations of the opposite side of the coal measures.

Section of Rock Strata at the Falls of the Cuyahoga. Order descending.

1. Yellowish colored, sandy, argillaceous earth, containing large quantities of argillaceous brown oxide of iron, in concentric, kidney-shaped masses. It has been dug and used in the adjacent furnaces. The surface is covered at this elevation with granite bowlders. The forest trees are principally chestnut and yellow oak.—10 feet.

2. Slaty sandstone, light gray color; argillaceous and breaking into small angular fragments, when exposed to frost and rain.—30 feet.

3. Bituminous shale, on which the sandstone reposes and forms the roof of the coal beds, after the shale is removed. The shale is filled with casts and impressions of fossil plants of various species: amongst them are numerous trunks of arborescent ferns, more than a foot in diameter, which, extending across the roof of the drift, a distance of eight feet, are lost in the adjacent shale. The ornamented surface of the tree is beautifully figured or impressed on the rock, coated with a thin layer of coal, like a natural epidermis. I was unable to remove any of them without injuring the roof, but from Mr. Newberry, the owner of the mine, received a few fine specimens, collected by the workmen. A drawing of one of the species is given at Fig. 12.—2 feet.

4. Bituminous coal. The quality of this coal is inferior to that nearer the centre of the coal fields. It contains considerable sulphur, and often slate: at some of the beds which I visited, it is coated with or discolored by iron rust. It is an interesting fact that no coal is found north of this spot; and the Cuyahoga is the only lake stream that passes through the coal deposits. In this instance, it is owing to the wide southerly sweep this stream makes into the northern border of the great coal basin. It is here found in only a few isolated, elevated spots, and is evidently the remnant of the deposit, left undisturbed by that overwhelming catastrophe, which strewed this region with granite bowlders, sand and gravel, and tore up and removed the rock strata around these solitary remnants.—4 feet.

5. Siliceous sandstone rock, of various qualities and colors, some of which is nearly white near the top: the lower part of the deposit, the common gray sandstone rock, is filled with casts of fossil trees, and Calamites of various species, amongst which are Calamites columnare, and Calamites dubia. This rock forms the base of the uplands, and rests on the loose conglomerate which constitutes the rock at the head of the falls, making the height of the uplands about one hundred and twenty six feet above the cliffs of the river.—80 feet.

6. Coarse, aggregate sandstone rock; loosely cohering, composed of coarse white gravel and small siliceous pebbles, imbedded in sand. It breaks and disintegrates easily. The head waters of the Cuyahoga, in Geauga County, rise in a region composed of this rock. It is very favorable to the formation of springs, which abound in these conglomerate deposits, and render the stream very durable in the summer months. This rock seldom contains any casts of fossil plants: some portions of it are nearly all sand, with some scattered gravel widely disseminated through it. It is seldom sufficiently compact for building stone, although I noticed some blocks of this rock at the head of the falls, prepared for this purpose.—15 feet.

7. Bituminous shale, with a trace only of coal.—1 foot.

8. Red sandstone—in many places of a deep red; structure, uniform; texture, compact and tolerably fine grained. It contains very little mica. It lies in beds of from four to eight feet in thickness, and can be split into blocks of any length desirable for architectural purposes, to which use it has already been extensively applied; several large, beautiful buildings having recently been erected of this material. It will probably afford the main building stone for a future city, as it is found in exhaustless quantities, and in very accessible situations, forming the upper portions of the cliffs of the Cuyahoga for several miles,—the whole length of the falls. It is the first and only locality north of the Ohio River, where I have seen this rock in place, although it is said to be abundant in Indiana. The upper portion of the deposit contains many fine casts of Calamites, with other fossil plants, and I think some animal remains, as I have two specimens, one of which is apparently part of a tooth, and the other a portion of the impression of some crustaceeus animal. The lower portion of the deposit is in some places beautifully variegated with undulating veins and plumose lines, from the ferruginous

sediment disposing itself in this form while in a plastic state, instead of being uniformly diffused through the whole mass of the sand, leaving portions of the rock of a yellowish cast. In other places which I noticed in the face of the cliffs, and also in masses which had fallen at their feet, the iron had formed thin concentric and curved lines, standing out from the rock in bold relief, presenting a very singular appearance, and giving rise, in common observers, to many crude conjectures and speculations as to their origin.

The whole deposit of red sandstone rock is 30 feet thick.

9. Coarse conglomerate rock, like a fine pudding stone, made up of small white pebbles and coarse gravel, all rounded and water-worn. The cement of this deposit is more siliceous than that of the upper bed, and constitutes a very hard compact rock, similar to the Laurel and Greenbrier Mountain rock, used for mill stones. It lies in beds of ten or fifteen feet in thickness, and in huge masses of fallen fragments from the face of the cliffs, down to the water's edge, above the clay slate, to be noticed presently. It shews few if any signs of fossil remains where I examined it, which was for half a mile in extent.—40 feet.

10. Coarse brecciated rock, composed of the fragments of sharp angular sandstone rock and pebbles, united by a brown ferruginous cement. This deposit contains many fragments of fossil remains, which, in the short period I had to examine them, appeared of doubtful character: some much resemble bones. Owing to the hardness of the breccia, and from their lying directly under the hard conglomerate above, with numerous blocks before it, they are removed with great difficulty. This stratum reposes on a thick bed of clay slate, and has, with several of the other strata, been brought to light by the cutting process of the waters in a long course of ages. It is accessible only by laborious approaches along the base of the cliffs.—2 feet.

11. Light blue clay slate, containing some mica, very fissile. It readily decomposes, and forms an abrupt sloping glacis down to the water's edge. It contains a few vegetable and animal remains of shells, of a very singular form, resembling Anomia. I have one or two fine specimens from this deposit. It also contains, at short intervals, concentric tabular masses of iron ore, several inches in thickness. This deposit, although of great depth, was easily broken up and removed by the rushing waters, and forms nearly half the height of the falls.—100 feet.

12. Granular lime rock, bluish color, very hard, and rather coarse grained. It makes a good hydraulic cement, and is applied to that use.—1½ foot.

13. Clay slate, with some impressions of the foliage of arborescent ferns.—6 feet.

14. Secondary graywacke, of Eaton; above which lies a thin bed of iron ore in tabular masses. The graywacke is very hard, and of a light gray color when first taken from the bed, but becomes more dark on exposure to the air, indicating a mixture of the oxide of iron. At this spot, about half a mile above the foot of the falls, this rock forms the bed of the stream, and at this point my examination of the strata ceased. Below this point several other deposits are brought to light, as the stream has cut through their beds. They are mostly varieties of graywacke and slate, as would appear from their description by Mr. Newberry. The whole series of rocks embraced in this section, amounts to three hundred and nineteen feet.

Travertine.—In the perpendicular crevices and clefts of the rock, a calcareous tufa, or travertine, is deposited from the springs which run at intervals down the face of the cliffs, as the water, from its lofty descent, evaporates in the air. Large masses of the rock occasionally fall, displaced by the wintry freezing, exposing these collections, many feet in thickness and several rods in length. The travertine often contains the bones and teeth of animals, generally of the deer, but occasionally of other animals, which have fallen into these crevices and perished. They are mostly recent, although I saw one or two that appeared to be of some extinct race. This tufaceous deposit, after calcination, is used by the inhabitants, for lime or cement, no other lime rock being found near the falls. At one spot which I examined, the travertine is now in a regular course of deposition, having added an eighth of an inch since last year, when a part of the mass was removed. The cliffs at the spot where my examination ceased, are about two hundred feet above the bed of the Cuyahoga. The common deer, when chased by dogs or wolves, sometimes leap these cliffs, and are dashed to pieces on the rocks below. Only a few days before my visit, a large buck was killed in this way. It is rather difficult and fatiguing to make one's way amidst the huge masses of rocks which line the feet of the cliffs. Occasionally a small stream of water rushes over the side of the rocks, and is lost in a sheet of foam below, especially where the projection is shelving: at some of these, like the table rock at Ni-

agara, we could pass behind the falling sheet. Beneath these projecting rocks, ice remains unmelted until the beginning of June: there was a considerable quantity lying there to-day. About midway of the falls, an immense block of the conglomerate rock, from thirty to forty feet in height, and more than that in diameter, being of a cubic form, lies in the middle of the stream, the water passing on each side of it: several large hemlock trees crown its hoary head; the roots piercing the crevices of the rock, find moisture and a steady support. The tops and sides of the cliffs are lined with fine large trees of the hemlock (Abies Canadensis) and white pine, (Pinus Strobus,) adding tenfold life and beauty to this romantic spot. I look forward with regret to the period, when these ancient and beautiful trees must fall before the increase of manufacturing buildings, which will soon supply their place. Almost my last words to the proprietors and influential inhabitants were, "Spare, oh spare these noble evergreens, so charmingly appropriate to the spot, and standing on the brink and sides of these romantic cliffs, where the hand of man can never replace them." At several points along the falls, the view up stream is grand and imposing. The immense cliffs of perpendicular rocks, crowned with the towering hemlock, whose tall shaft in many places hangs gracefully over the gulf below, as if listening to the voice of the waters, which, confined to their narrow bed by the rocky walls of the stream, come foaming through with headlong fury. In some places there is a descent of eight or ten feet at a single bound; at others, it rushes down an inclined plane. The greatest pitch is twenty two feet in a distance of ten feet, but accomplished at two leaps. This long succession of falls and rapids will ultimately become of incalculable benefit to the manufacturer, and a cordon of mills and machinery may be continued without interruption, touching each other like the houses in a crowded street, for the distance of two miles on each side of the stream; the same water being used successively at the different dams, and taken along the sides of the river in plank raceways or penstocks. From its proximity to two canals, leading to the two greatest cities in the Union, this spot is destined to become in a few years a place of great commercial importance and immense manufacturing business. The town now contains eight hundred inhabitants, and it is supposed by good judges that two hundred buildings will go up the present year. The manufactures now in operation are, a paper mill, oil mill, flour mills, saw mills, sash manufactories, smitheries, &c. &c.

Plan of Cuyahoga Falls and vicinity, with the Ohio Canal, &c.

References.—P, Old Portage; O, O, O, Ohio Canal; B, Little Cuyahoga; C, Cascade or North Akron; *a, a, a,* Locks; *m,* Mill Race.

Cuyahoga village.—The town is called "Cuyahoga Falls;" it lies on the line between the townships of Stow and Talmadge. The annexed plan will give a view of the course of the river; the location of the villages in this vicinity; the principal pitches or cascades, in feet; course of the Ohio Canal, and its descent into the valley of the Cuyahoga, below the falls. The water furnished by the Cuyahoga, at its lowest stage, has been carefully estimated at four thou-

sand cubic feet per minute, and for more than half the year it affords five times this quantity. For the convenience of visiters, Mr. Newberry has erected a strong and safe flight of steps, by which to descend to the foot of the cliffs, at a point which affords a fine view of the falls, and where the perpendicular walls are more than one hundred feet high.*

Old Portage, May 15.—The apple is but just fairly in blossom at this place, while at Marietta the blossoms had fallen ten days since. There was a slight frost this morning. The old portage from the Cuyahoga to the Tuscarawas, passed across the tract between these two streams, beginning at the foot of the falls, and taking a southerly course. The distance was about ten miles, and was the route pursued by the savages, and by Indian traders in early days. After the peace of 1795, white men occupied the same route in carrying goods and merchandise from the Lake to the towns on the heads of the Muskingum River, and even as low down the stream as Zanesville, as late as the year 1805 or 1806. We left Cuyahoga Falls at 9 A. M., crossing the Little Cuyahoga, a fine mill stream, after travelling two miles in a southerly direction; and shortly after the small canal that conducts the water from the Little Cuyahoga to the fourth lock, below the summit level. The village, where it terminates, is called "Cascade," from the rapid descent of the water for the use of machinery. The water power thus acquired is very great. This village lies half a mile below the town of Akron, and will in a few years be united with it in a continuous street, so that the towns can only be distinguished by the "Cascade" portion, and the "Akron" portion. The waste weirs furnish an immense amount of water power, a considerable portion of which is already occupied by mills for flour, furnaces, &c. The population in the two villages is said to be fifteen hundred. In travelling from "the Falls" to the summit level, we passed through the village of Middlebury, a very thriving and industrious place, seated at the falls of the Little Cuyahoga. This stream is about thirty yards wide, and takes its rise in

* Cuyahoga village is by far the most bustling and active town I have seen in my journey. The demand for lots and new buildings, has given an impulse to every thing; while the rush and hurry of the waters, and rapid motion of the saw mills, has communicated, by sympathy, a quickening influence to the muscular motions of the inhabitants, which to me was very striking and apparent. The joiners, in planing a board, made three strokes with the plane, in the same time that I ever saw two made at any other spot. The same rapidity of movement was perceived in every other action, which may be rationally explained in no other way than by the power of sympathy.

some large ponds, one of which lies in Stark County. In hurrying along to join its waters with the larger stream, it has to pass over the same rocky deposits, which make the falls of the main Cuyahoga. They however are not so much elevated, and of course offer less obstruction. This fall, or succession of falls, continues for more than a mile, and affords great facilities to the mechanic and manufacturer. The village of Middlebury is at this place, and carries on an extensive business in many kinds of manufactures common to the west. The population is about six hundred. The increased value of landed estate in this region, embracing a space of not more than four miles square, is really astonishing. The rapid progress of Rochester, N. Y., is known to have been a standing wonder, but the increase in this spot will far surpass that. The immense, I may almost say endless, water power, the passage of two canals so near their doors, and the extensive and rich agricultural region around them, afford advantages not to be found in any other spot west of the mountains. Several furnaces are in operation at Akron, the ore which they use being brought from Tuscarawas County, on the canal. While at the former place, I observed a boat load of crystalline sulphate of lime, white as the driven snow, thrown carelessly on the landing, amongst the dirt. It costs about six dollars a ton. It is in large masses, and in some parts of the world would be thought valuable, for alabaster vases and other ornaments. It is brought from Sandusky Bay, where it is found in great quantities. This beautiful mineral is used in some counties on the Muskingum for agricultural purposes. At Akron, I took passage in a canal boat. The canal here passes through the Portage lake, which we entered soon after. It is a beautiful sheet of water, bordered on the west side by a Tamarack swamp. Near this pond are several others of considerable magnitude, abounding with fine fish, and the Nymphæa, or fragrant water lily. Peat is found in abundance, in nearly all these swamps, which border the outlets of the ponds. Within the compass of a few miles on the summit level, there are not less than ten or twelve ponds of considerable magnitude. Some of them discharge their surplus waters into the Tuscarawas, others into the lake streams: across this level the canal runs the distance of ten miles without a lock. It is but a few years since these ponds were the favorite haunts of the beaver, and many a rich package of furs has been taken here by the Indians and by the border hunters. There was a time when ponds were much more numerous than now.

The swamps and peat marshes, with the growth of trees and shrubs, have gradually encroached on their limits, until several, within the recollection of old hunters, have changed their character from pond to swamp; and these, after a few years, will, by drainage and cultivation, pass into meadows. After passing the first lock, eighteen miles north of Massillon, the face of the country begins to descend very gently to the south, and affords fine lands for agricultural purposes, lying on long slopes and gentle undulations, clothed with beautiful forest trees.

Course of the Canal.—After crossing the line of Stark County, which we did directly after dusk, the canal enters upon the N. W. border of the great coal basin. It continues near the margin of the basin as it advances south, down the waters of the Tuscarawas, for the distance of one hundred miles, until it reaches the waters of Licking, when, turning up to the west, through "the narrows of Licking," it emerges upon the great tertiary region west of the coal measures. Passing over the Licking summit, through the "deep cut," and down the Scioto Valley, it again enters the hills below Chilicothe, and passes out through the S. W. border of the coal and iron deposits, into the Ohio River.

Marl Beds.—The eastern line of Wayne County lies near the route of the canal. The two counties last mentioned contain extensive tracts of rich prairie and rolling uplands. In the wet prairies, beneath a bed of black vegetable earth, are found immense deposits of marl, so rich in calcareous material, that when burnt it answers the purposes of lime, and is used in making cements and plaster, for buildings. These beds will furnish inexhaustible supplies of the richest manure for the sandy plains which stretch along the Tuscarawas. The marl deposits run east and west for many miles, and are found near Canton, in the centre of Stark County. When these calcareous beds shall be thoroughly examined, they will doubtless afford many fine fossil shells of the tertiary series.

Massillon, May 16th.—Stark County has a population of about 25,000, many of whom are emigrants from Germany and France. It is fast rising into wealth and importance. We passed through Massillon early this morning. It is a town of considerable magnitude, and carries on an extensive business in merchandise and agricultural productions. The buildings are generally larger and better than in most new towns; many of them are constructed of brick. There are four large flouring mills, an oil mill, furnace, woolen manufac-

tory, &c. The machinery is moved by water, furnished in part by the canal, and partly by the Tuscarawas, now become a large stream, while just below the summit it is only a small brook. The amount of wheat grown in this region, and sold at Massillon, is very great; from thence it passes to New York. Wool is also another staple article of produce. Large flocks of fine wooled sheep were brought here in the early settlement of the county, and have increased greatly.

Fossil Bones.—In excavating a mill race through a swamp, or a wet prairie, near Massillon, a year or two since, some very large bones and tusks of the mastodon were brought to light.

Barrens.—Just below Massillon commences a series of extensive plains, spreading over a space ten or twelve miles in length from east to west, and five or six miles in width. These were covered with a thin growth of oak timber, and were denominated barrens; but on cultivation they produce fine crops of wheat. The Tuscarawas has cut across these plains on their western end, and runs in a valley of denudation, sunk about thirty feet below the level of the general surface of the plains. Some of the lower levels are wet, and filled with red cedar, black alder and the beautiful climbing multiflora rose, (Rosa rubifolia.) The tamarack disappears as the country becomes more dry, and descends to the south. A few miles below Massillon we passed Navarre and Bethlehem, both of them flourishing villages on the borders of the canal. The progress of improvement is astonishingly great through all this part of Ohio.

White Sandstone Rock.—A deposit of fine, white granular sandstone, makes its appearance here near the surface of the hills. It is found in great purity, containing little else than silex, and is used in the manufacture of white glass at Zanesville. An equivalent rock is very prominent in that series of deposits, which make their appearance on the tops and sides of the Laurel and Sewell Mountains on the south and east borders of the great coal basin. The mineral characters of this sandstone are similar to those of the rock found in boring for salt water in the valley of the Muskingum at the depth of six and eight hundred feet. I have specimens from several of these borings, and from the places above named, which are so similar as to suggest the possibility of their being portions of an equivalent, if not the same, deposit.

Tuscarawas County.—About 9, A. M., the boat crossed the north line of Tuscarawas County. This is a rich and very fertile

county of rolling uplands, cultivated by an industrious population of German descent. It contains at present about twenty thousand inhabitants, and is nearly thirty miles square. Soon after entering the borders of this county, we passed the village of Bolivar. It is a town of considerable importance, and fast rising into notice, as the point where the Sandy and Beaver canal will unite with the Ohio canal.

Sandy and Beaver Canal.—This canal will be seventy six miles in length, and is now under contract. Bolivar is forty two miles south of Akron. The canal terminates on the Ohio River, at the mouth of Little Beaver, fourteen miles below Big Beaver, and will be continued to the Pennsylvania and Ohio canal, and thence to Pittsburgh, opening a new route from the eastern cities to the most fertile and productive portion of Ohio. This canal is also owned by a joint stock company. The water for its supply will be furnished by Sandy Creek and Little Beaver.

Fort Lawrence.——A few miles south of Bolivar, the canal passes through the earthen walls of old Fort Lawrence, once the scene of border warfare, and of bloodshed. The parapet walls are now four or five feet high, and were crowned with pickets made of the split trunks of trees. The ditch is nearly filled up. The walls enclose about an acre of ground, and stand on the west bank of the Tuscarawas. Fort Lawrence was erected in the fall of the year 1778, by a detachment of one thousand men from Fort Pitt, under the command of Gen. McIntosh. After its completion, a garrison of one hundred and fifty men was placed in it, and left in the charge of Col. John Gibson, while the rest of the army returned to Fort Pitt. It was established at this early day in the country of the Indians, seventy miles west of Fort McIntosh, with an expectation that it would act as a salutary check on their incursions into the white settlements south of the Ohio River. The usual approach to it from Fort McIntosh, the nearest military station, was from the mouth of Yellow Creek, and down the Sandy, which latter stream heads with the former, and puts into the Tuscarawas just above the fort. So unexpected and rapid were the movements of General McIntosh, that the Indians were not aware of his presence in their country, until the fort was completed. Early in January, 1779, the Indians mustered their warriors with such secrecy, that the fort was invested before the garrison had notice of their approach. From the manuscript notes of Henry Jolly, Esq., who was an actor in this,

as well as in many other scenes on the frontiers, I have copied the following historical facts. "When the main army left the fort to return to Fort Pitt, Capt. Clark remained behind with a small detachment of U. S. troops, for the purpose of marching in the invalids and artificers who had tarried to finish the fort, or were too unwell to march with the main army. He endeavored to take the advantage of very cold weather, and had marched three or four miles, (for I travelled over the ground three or four times soon after,) when he was fired upon by a small party of Indians very close at hand, I think twenty or thirty paces. This discharge wounded two of his men slightly. Knowing as he did that his men were unfit to fight Indians in their own fashion, he ordered them to reserve their fire, and to charge bayonet, which being promptly executed, put the Indians to flight, and, after pursuing a short distance, he called off his men and retreated to the fort, bringing in the wounded." In other accounts I have read of this affair, it is stated that ten of Capt. Clarke's men were killed. "During the cold weather, while the Indians were lying about the fort, although none had been seen for a few days, a party of seventeen men went out for the purpose of carrying in firewood, which the army had cut before they left the place, about forty or fifty rods from the fort. Near the bank of the river was an ancient mound, behind which lay a quantity of wood. A party had been out for several preceding mornings and brought in wood, supposing the Indians would not be watching the fort in such very cold weather. But on that fatal morning the Indians had concealed themselves behind the mound, and as the soldiers passed round on one side of the mound, a part of the Indians came round on the other, and enclosed the wood party, so that not one escaped. I was personally acquainted with some of the men who were killed." The published statements of this affair say that the Indians enticed the men out in search of horses, by taking off their bells and tinkling them; but it is certain that no horses were left at the fort, as they must either starve or be stolen by the Indians; so that Mr. Jolly's version of the incident must be correct. During the siege, which continued until the last of February, the garrison were very short of provisions. The Indians suspected this to be the fact, but were also nearly starving, themselves. In this predicament, they proposed to the garrison, that if they would give them a barrel of flour and some meat, they would raise the siege, concluding if they had not this quantity they must surrender

at discretion soon, and if they had they would not part with it. In this, however, they missed their object. The brave Col. Gibson turned out the flour and meat promptly, and told them he could spare it very well, as he had plenty more. The Indians soon after raised the siege. A runner was sent to Fort McIntosh with a statement of their distress, and requesting reinforcements and provisions immediately. The inhabitants south of the Ohio volunteered their aid, and Gen. McIntosh headed the escort of provisions, which reached the fort in safety, but was near being all lost from the dispersion of the packhorses in the woods near the fort, from a fright occasioned by a *feu de joie*, fired by the garrison, at the relief. The fort was finally evacuated in August, 1779, it being found untenable at such a distance from the frontiers; and Henry Jolly was one of the last men who left it, holding at that time in the continental service the commission of ensign.

Zoar.—The boat reached Zoar at 11, A. M., where I disembarked. This little "city of refuge" is beautifully situated on a rising ground on the east side of the Tuscarawas. It was settled by an industrious community of Germans, from Wittemburgh, on the river Elbe, while yet covered with a dense forest, in the year 1817, under the patriarchal charge and pastoral care of Jacob M. Biemler. They are seceders from the Lutheran church, as a religious community. Mr. Biemler is now about sixty years of age, of mild manners and prepossessing appearance. He acts both as their spiritual and their temporal guide, directing their secular affairs with great prudence during the week, and their spiritual concerns on the Sabbath. He is assisted by a council of two or three elders, and in very important matters the whole male population have a voice. Their first purchase embraced four thousand acres, to which they have since added two thousand more.

The nett profit of their labor goes into a joint stock. If an individual leaves the community, which is a rare occurrence, he draws from the funds a sum equal to the amount by him first invested, but nothing for his labor over and above the sustenance he has received. A part of the laboring class are employed in agriculture, and a part in the various mechanical pursuits necessary to the comfort of the village. Each family draws from the various deposits all the articles of domestic use needed for its support. The surplus is added to the general fund. They have a common school, at which all the children are equally taught. I passed the afternoon in company

with Mr. Biemler, (to whom I had a letter of introduction,) examining the improvements of these industrious people. The language spoken is German, so that in the short space of a few minutes I was transferred from the mixed jargon of a western canal boat, into a community whose dialect, dress, buildings and manners, were assimilated to what is seen in the heart of Germany, and to the middle of the seventeenth century. There was something so patriarchal and primitive in all around me, that I was delighted with the transition. Their present population is about three hundred. The buildings are generally of frame work, some filled in with bricks, and with high pointed roofs. They are covered with red tiles, made of the common clay of the country, burnt very hard, so as to be durable, and they look well because they are durable. Manufactures of flour, woolen, linen, leather, &c., are all carried on, and recently a large furnace has gone into operation near the margin of the canal. A substantial wooden bridge crosses the Tuscarawas, here about eighty yards wide. From the top of the Zoar hotel, which is surmounted by a handsome cupola, there is a delicious prospect of the surrounding country. The lands of the colony lie on both sides of the river, stretching out into broad hills and wide finely cultivated alluvions, through which the Tuscarawas winds for four or five miles, bordered with the richest verdure; all kinds of cereal productions suited to the climate, here find congenial soils. The meadows are very fine, and the banks of the river are so low as to admit of irrigation, thus producing a succession of crops on the same field: amidst other articles, I noticed a large field of rape, with its bright yellow blossoms now fully expanded. The seed yields a fine oil, suitable for lamps. The Germans are every where noted for their taste in the cultivation of fine flowers. This little "city of refuge," although so far removed from the "fader land," and seated in the wild woods of the Tuscarawas, instead of the classic groves of the Elbe, keeps up an extensive garden, and one of the finest green houses I have ever seen. It contains a number of lemon and orange trees, at least twelve feet in height, filled with the richest fruit; and a large number of rare exotic plants and shrubs in full bloom, filling the large and lofty room with the richest perfumes. The house is kept with the utmost neatness and order. A flower and vegetable garden of two acres, laid out with great beauty and in the best German taste, slopes gradually to the south in front of the green house. Here the choicest peaches, pears, plums and grapes, are also cultivated. A

large vineyard on the side of an adjacent hill, gave promise of a luscious harvest, and added one more feature to the exotic look of all around. A stratum of white sandstone rock is found in all the adjacent hills, at an elevation of about one hundred feet above the bed of the river. It is used for window sills, and various other purposes. The lower portion of the bed is stained with red oxide of iron. It splits with great facility, and is used for posts in fencing the Zoar garden.

Ferruginous Deposits.—The great ferruginous deposit, which crosses the state like a belt, in a S. W. and N. E. direction, is here found in its greatest purity and abundance. It first makes its appearance about five miles north of this place, and is known to extend south for at least thirty miles. It does not hold of this width for the whole distance across the state, but can be traced without difficulty from near the mouth of the Scioto to Conneaut on the Pennsylvania line. It lies here about forty or fifty feet above the white sand rock, and near the tops of many of the hills. The ore is found in three separate beds, of about six or eight inches in thickness, and about two feet apart, lying in a matrix or bed of yellow ferruginous clay. The bottom stratum of ore rests on a deposit of bluish brown clay, which when dry assumes a foliated structure, and is very similar to that found in the bottoms of ponds. These deposits were once continuous, but are now found in broken tabular masses, of from ten to one hundred pounds weight. Its structure is lamellar, splitting into thin folia, or concentric layers, when exposed to the air and sun. The ore is very abundant, and yields from eight to nine hundred tons from an acre of surface. In the furnace, it affords about forty per cent. of iron, or two and a half tons of ore yield one ton of pig metal. It crops out on the abrupt and sloping sides of the hills, near their tops, and is yet pursued only so far as it can be done by excavating the superincumbent earth. I visited the mines on the Zoar lands, where it is found in great purity and abundance. Directly over the iron ore is a deposit of coal, of two or three feet, separated from it, however, by a bed of shale. Below the ferruginous deposit is another bed of coal; and near the base of the hills, fifty feet below the white sand rock, is a deposit of limestone, several feet in thickness. I could not discover any fossil shells, or impressions of plants, in the iron ore; but one bed of it, however, is columnar in its structure, when burnt, or roasted, much resembling one species of fossil madrepore, common to the valley

of the Ohio. The deposit is very abundant in all the hills, and large heaps of it are seen along the sides of the canal, for the use of the furnaces north of the iron region, along the Tuscarawas. As we descend the river south, coal becomes more abundant, and the ore dips down to the base of the hills, and finally disappears under the superincumbent strata. Salt water has not yet been found here, although searched for to the depth of three hundred feet. It is very abundant thirty or forty miles east of Zoar, on the waters of Yellow Creek. The community at this place is in a very flourishing condition, and shows what the united efforts of a few hundred individuals can accomplish, when cemented by love and the holy offices of religion. Owen's attempt at communities was founded on a similar plan, but lacked the strong bond of religious rites and feelings, without which man every where loses all nice sense of right and wrong. They appear to be a very happy society, and I do not see how they could be otherwise, while under the care of so sensible and pleasant a guide as Jacob M. Biemler. I left this interesting spot at sunsetting, and proceeded southerly through a well cultivated and very fertile region. The amount of wheat raised in this vicinity is very great, the soil and climate being both congenial to its natural habits.

Bivalve Shells.—The canal promises to be of great importance to conchologists, as well as to agriculturists. Wherever there is "a feeder" putting into the canal from the main streams, as for instance the Tuscarawas, Licking or Scioto, the bottom of the canal is literally covered at this time with the most perfect and beautiful specimens of bivalve shells. This is especially the fact at Zoar, Newark and Chilicothe. The soft sediment, and the absence of any current to abrade their surfaces, preserve them with their delicate markings unharmed, while in the rivers with gravelly bottoms, the cuticle is always much worn and injured. Who, that has ever paid any attention to the study of conchology, or searched one hour in our streams for shells, does not know, that like land animals and like plants, different species seek different localities as a habitat, where they find a soil, food and climate congenial to their wants. Some species live under flat stones, in rapid water; others in clay, mud, sand, &c. Some lie on the surface, and others deeply buried in gravel, beneath the bottoms of the streams. This is the fact with the Unio oriens and U. Soleniformis. The latter species I have never yet found in a living state, although I have often picked up the shells of the recently dead, for the reason that they live in deep water and are buried in mud. The

western country is prolific in species of insects, plants and land animals, without limit; and shall these immense waters, embracing nearly one fourth of a hemisphere, be restricted according to the opinions of some to a few species of bivalve shells, and those only such as are common to both sides of the Alleghany Mountains? A still stronger proof than that of analogy, is found in the specific differences of the molluscous animals themselves. Dissections and comparative examinations of the animals, show a specific difference, even stronger than the outlines of the *calcareous coverings.* I have myself dissected many shells, for this very purpose. It is furthermore contrary to the general economy of nature, to bring forth and perpetuate *varieties*, either of plants or animals, except when under the cultivation and artificial direction of man.

Dover.—Ten miles below Zoar, we passed the village of Dover, with four or five stores, and two or three large flouring mills. The sites for water power machinery, along the canal, are very numerous, and as yet only partially occupied. The Tuscarawas winds through broad and rich bottom lands, in many places more than two miles wide from hill to hill. The adjacent country is moderately hilly, and clothed with dense forests, which are every where fast falling before the axe of the woodman, and rich wheat fields, orchards and meadows are occupying their place.

Newcastle—Coal.—May 17: Sixteen miles below Zoar, at Newcastle, coal is found at a less elevation, and much more abundant. The deposit here is six feet in thickness, and extensively worked. Wooden slides, on the sides of the hills, conduct the coal from the mouths of the mines to reservoirs on the banks of the canal; from thence it is carried in boats to the summit, and to the valley of the Scioto. It is said to be of an excellent quality. At the present day, with all the lights that have been thrown upon the subject by chemistry and the study of fossil plants of the coal series, no well instructed and sound geologist would hazard the long exploded theory of the *mineral origin of coal*, by *ejection* from the interior of the earth. Although some bituminous shales are destitute of the impressions of plants, more than nine tenths of them abound with these authentic proofs of the vegetable origin of coal; and I have never seen a piece of slaty bituminous coal, from any part of the valley of the Mississippi, that was not filled with thin layers of vegetable fibres, resembling charcoal, and lying between all the horizontal folia of the specimen. Whence all these impressions of

leaves and charcoal, but from a vegetable source? Bitumen is rarely if ever found, but petroleum is abundant in the West. Its origin is plainly from vegetable decomposition,—the same source as that of the carburetted hydrogen, namely, from the coal beds under the valley of the Ohio. The vegetables forming these were deposited when the lime was in a plastic state, and filled with living shells; in the same manner petroleum is now daily discharging into the soft mud and gravel, in the beds of the Little Muskingum and Hews's River. It will be found by future geologists, when those sands shall become consolidated into rock, lodged in cells formed by the contained gases. That bituminous coal is not a mineral matter, is evident from the fact that it is not found in primitive rocks; probably because, that at the period of the formation of the deeper primary rocks, no vegetable productions were in existence; for the relics of none are found until near the period of the transition or secondary rocks, unless we ascribe the plumbago to a vegetable origin, in which case the first plants will have been coeval with the earliest slaty rocks.

Gnadenhutten.—Gnadenhutten, or "Tents of Grace," the scene of the missionary labors of the pious and humane Heckewelder, is seated on the river, twenty five miles below Zoar. The ancient Indian village was placed on a broad elevated plain, on the east side of the stream. These simple sons of the forest had become docile as children, under the gentle guidance of the Moravian teachers: a large number of them were truly pious, and members of the church of Christ. Seated on the frontiers between the contending savages and the whites, and taking sides with neither, they had become obnoxious to both, and were cruelly murdered in cold blood, to the number of ninety four, in April, 1782, by Col.'s Williamson and Crawford, and party—the Sandusky Indians, accusing them of being friendly to the whites, and the whites charging them with secreting the stolen property brought by the war parties on their return from the settlements. How often the fate of these poor Indians is verified in modern warfare; the quiet and unoffending neutral is plundered and abused by both the belligerent parties. Filled with the spirit of revenge, in the month of March, 1782, a party of eighty or ninety mounted men, under the guidance of Col.'s Williamson and Crawford, took their departure from the "Old Mingo Bottoms," the well known rallying ground of border warfare, destined for the Moravian villages on the Tuscarawas. The Indians, thinking of no

evil, were busily engaged about their domestic concerns, and offering no resistance, suffered themselves to be all taken prisoners, to the number of ninety four. More than half of these were women and children. In the morning, when told what was to be their fate, they mutually prayed, and exhorted each other to be resigned, and asking reciprocal forgiveness, prepared for death. Before the order for massacre was finally issued, some of the more humane men made application to Col. Williamson for liberty to take a child apiece to their homes and save their lives, there being not less than thirty or forty. Williamson, after considering a minute, answered that there were not children enough for them all to have one, and lest there might be any complaining, he thought it better to let them remain on the spot with their parents and relatives: accordingly they were all massacred in cool blood, and after a night's rest for reflection. In the heat of battle, and at the sacking of a town, there may be some excuse for the indiscriminate slaughter that sometimes takes place; but in the whole annals of American warfare, no scene of deliberate murder can be found that equals this in atrocity. This tragical story was related to me, a few days since, by a man now more than eighty years old, who was present, and one of the number that made application for liberty to save one of the children. He was well acquainted with Williamson, the principal actor, and says that he died poor and miserable, and that a large number of the men perished by violent and untimely deaths. He was one of the party under Williamson and Crawford, at the defeat in May following, on the Sandusky plains, where Crawford was taken prisoner and burnt, and most of his men killed. I also conversed with a man on the spot, for many years a resident here, who said that when a boy he had often seen, with mingled feelings of horror and detestation, the black-walnut stump on which many of the poor Indians were beheaded. He also confirmed the popular impression, by saying, that the larger number of the men engaged in this murderous business, either came to an untimely end, or suffered losses of property and other calamities, too striking not to be noticed as marks of the retributive justice of heaven. The alluvial lands at this spot are nearly two miles wide, and very fertile. The Tuscarawas is about ninety yards in width, with low banks and a placid current, gliding gently along, a silent, but a still living witness, of the atrocities committed on its shores.

Rev. John Heckewelder.—Gnadenhutten was first settled by the Moravian missionaries in the year 1772. Another missionary station was formed a few miles below, at Salem, by Mr. Heckewelder, in the spring of 1780. Sarah, his wife, here resided with him in perfect safety, and in the fullest confidence of security, amongst their Indian converts. The 16th of April, 1781, was the birth day of their daughter Maria, who it is believed was the first white child born within the present limits of the State of Ohio. She is still living in Bethlehem, (Penn.) In the autumn of that year, the Indians and missionaries were forcibly removed to Detroit, by the Sandusky Indians, leaving all their crops of corn standing in the fields. Having suffered much from a want of food during the winter, a part of the Indians returned in March to save what was yet left, at which time the massacre took place. While dwelling on the incidents of this interesting spot, I cannot refrain from adverting to a singular trait in the character of Mr. Heckewelder, that of believing in the power of foretelling future events. He had lived so many years secluded in the deep forests, and had, in the eye of his mind, seen the Indians so often at their labors, and his visions had been so often verified, that he had insensibly imbibed a belief that the human mind may become so deeply impressed with the approach of future events, as to predict their arrival with certainty. From certain occurrences, he was led to believe that he was himself possessed of this faculty: whether he acquired it from the dreamy kind of life he led in the wilds of the Tuscarawas, or from actual intercourse with spiritual existences, similar to those of Swedenborg, it will be difficult at this day to determine, but certain it is that many devout and pious minds have often been similarly constituted. The following singular fact I have from an ocular, and still living witness: During the early years of the settlement of the Ohio company at Marietta, Mr. Heckewelder was a frequent and a welcome guest. He there found men of learning and taste, whose society was congenial, and where he could again enjoy the comforts and refinements of social life. While many of the early settlements were composed of the ignorant, the vulgar, and the rude, the colony at Marietta, like those of many of the ancient Greeks, carried with it the sciences and the arts; and although placed on the frontiers, amidst the howling and the savage wilderness, exposed to many dangers and privations, there ran in the veins of its little band some of the best blood of the country, and it enrolled many men of highly cultivated minds and ex-

alted intellect. Amidst such a society, Mr. Heckewelder could not but pass his time pleasantly. He was himself a man full of the milk of human kindness; a great lover of horticulture, and all the beauties of nature, and much devoted to the study of the natural sciences. He kept for many years at Gnadenhutten a regular meteorological journal of the seasons, and of the flowering of plants, &c., which was published in Barton's Medical Journal. From his thorough knowledge of the Indian languages, he had been employed by Gen. Rufus Putnam, as an interpreter, at the treaty which he held with the Indian tribes at Vincennes on the Wabash, in Sept. 1792. This duty had been accomplished, and the General had returned as far as the falls of Ohio, where he was detained by an attack of autumnal fever, then common on the Wabash. Mr. H. had in the mean time returned by land to Marietta, in company with some of the Delaware Indians. The only intercourse then sustained between distant places, except for hunters and warriors, was by water, in canoes or barges. This journey had thus far been performed in a very light barge, built of cedar, and rowed by twelve men. As his fever had somewhat abated before Mr. H. left him, and the season was now advanced into November, the General's family at Marietta were daily expecting him, and were with great anxiety waiting for news. No news however could be obtained. Mrs. Putnam, with whom Mr. Heckewelder lodged, had become very uneasy and alarmed at the long delay of her husband, and it had been the subject of conversation before retiring to rest. In the morning, when Mr. H. appeared at the breakfast table, he told Mrs. Putnam with a smiling countenance, that he had good news for her of the General; and proceeded to state, that in the course of the night he had had one of those mysterious communications in relation to coming events, that had often been made to him during the course of his life, and which he had never known to deceive him. He said the General would return in safety on the 18th day of that month; and lest he should forget the day, he had in the night marked on the whitewashed chimney by the side of the bed, the number, with a piece of cut money he had in his pocket. My informant, who was then a boy, and lived in the General's family, immediately ran up stairs and examined the spot pointed out. There he found the figures 18 plainly marked in the side of the chimney by the bed. This was eight or ten days before the prophetic time. The days were carefully counted, and as the period approached, many an anxious look

was cast down the placid stream, in search of the coming barge, when lo! on the precise day, early in the morning, the boat reached the landing at "Campus Martius," the name of the stockaded fort at Marietta, with the General and all the party in safety.

Iron Ore.—As the canal boat proceeded south, I observed nodules and blocks of iron ore on the sides and surface of the hills, at a much less elevation than at Zoar. Vegetation has made a striking change since we descended into the lower portions of the valley. The petals of the Cornus florida are fully expanded and beautifully white; while on the summit they are yet quite green, and just beginning to unfold. The weather is very cool for this season of the year, and the forest trees are late in opening their foliage. Towns and villages are springing up so rapidly on the borders of the canal, that the inhabitants are at a loss for names. To-day we passed one in this awkward predicament, which goes by the epithet of "Newcomers-town." We crossed the Walhouding or White woman's river, near its junction with the Tuscarawas. After uniting their waters, the stream is called the Muskingum, or "Elk's-eye." The canal crosses the Walhouding in a wooden trunk, supported by two abutments and four pillars of masonry, faced with oval buttresses of sandstone rock. The stones which compose these huge pillars are very large, and rough dressed, projecting beyond the joints, giving the appearance of vast strength, and resembling the mural face of a natural cliff of sandstone rocks. It looks much better for this purpose than a smooth dressed stone, and is very creditable to the taste of the architect. This stream is about eighty yards wide, and has its sources in the northern and central parts of the state, in a very fertile region. Vernon river, once known by the euphonous name of "Owl Creek," is one of its principal tributaries. Kenyon College is situated on this beautiful stream. The Walhouding crosses the great siliceous deposit, in the N. W. part of Coshocton County, where we now are. I picked up several large fragments of flint and hornstone, on the beach, at the foot of the aqueduct. This singular and interesting deposit passes through the eastern portion of Holmes County, and crosses the Tuscarawas River not far from New Philadelphia, beyond which, easterly, I have no correct knowledge of its course.

Roscoe.—Just below the aqueduct, is seated the little village of Roscoe, on the west side of the Muskingum River. It is a village of some importance, and has several mills in operation.

Coshocton County.—Coshocton County contains about fourteen thousand inhabitants. Its surface is hilly, but very fertile and productive in wheat and other grains. The hills abound in bituminous coal and iron ore. Several salt wells have been sunk in the county, on Wills Creek, and on the Muskingum, which make considerable salt. The wells are not deep, and are probably connected, on the north western margin of the saliferous deposits.

Town of Coshocton.—Coshocton, the seat of justice for this county, is finely situated at the junction of the Tuscarawas and the Walhouding rivers. The ground on which it is built, lies in four broad natural terraces, each elevated about nine feet above the other. The last one is nearly one thousand feet wide. The situation could hardly be altered for the better by the hand of man. The present population is about five hundred.

Ancient cemetery.—A short distance below Coshocton, on one of those elevated, gravelly alluvions, so common on the rivers of the West, has been recently discovered a very singular ancient burying ground. From some remains of wood, still apparent in the earth around the bones, the bodies seem all to have been deposited in coffins; and what is still more curious, is the fact that the bodies buried here were generally not more than from three to four and a half feet in length. They are very numerous, and must have been tenants of a considerable city, or their numbers could not have been so great. A large number of graves have been opened, the inmates of which are all of this pigmy race. No metallic articles or utensils have yet been found, to throw light on the period or the nation to which they belonged. Similar burying grounds have been found in Tennessee, and near St. Louis in Missouri.

Coal.—The main deposit of coal, near Coshocton, is said to be nine feet thick, and lies much lower in the hills than at Newcastle. It is probably the same stratum that is found below the bed of the Muskingum River, at Zanesville.

May 18*th.*—We left Roscoe and passed down the Muskingum valley, generally near the base of the hills, to Websport, a small village of warehouses on the canal. At this point a side cut is taken out to the Muskingum River, across the bottom lands, which here are more than two miles wide, and continue nearly of this width for eight or ten miles up and down the river. From the outlet of this side cut, dams are to be thrown across the stream at intervals, for a slack-water navigation to the town of Zanesville, a distance of four-

teen miles. A little south of Websport, the canal leaves the Muskingum alluvions, and rises with the aid of two locks into the valley of the Wakatomika, a large creek, with wide and very fertile bottoms. After leaving this valley by a pretty deep cut, the canal passes into the valley of Licking, in which are seated the villages of Irville and Nashport. After the canal enters the Wakitomika valley, it turns more westerly, and a short distance beyond Nashport strikes the Licking River, which is here about fifty yards in width. It is now about to emerge from the coal measures, which it has traversed more than one hundred miles, into the tertiary deposits of the Licking and Scioto valleys. A dam is thrown across the stream at this point, and by the aid of a lock the boat passes into the river, which now performs the office of a canal, for the distance of two miles, through "the narrows of Licking," the tow-path being cut out of the solid sandstone for the larger portion of the way.

"*Black Hand*"—*Narrows of Licking.*—This is a very picturesque spot; cliffs of sandstone rock, fifty feet in height, line the sides of the canal, especially on the left bank of the stream. In some places they hang over in a semi-circular form, the upper portion projecting, and defending the lower from the rains and weather. In one of these spots, the aborigines chose to display their ingenuity at pictorial writing, by figuring on the smooth face of the cliff, at an elevation eight or ten feet above the water, the outlines of wild animals, and amongst the rest the figure of a huge, black, human hand. From this circumstance, the spot is known to all the old hunters and inhabitants of this vicinity, by the name of "the black hand narrows." It is the scene of many an ancient legend, and wild hunting story. At the point where the canal touches the Licking, the rock strata in the banks and bed of the stream dip to the north, at an angle of nearly fifteen degrees. As we ascend the stream, the inclination becomes less, and finally at the western outlet of the narrows assumes its usual horizontal appearance. It is a wild, romantic spot, and has evidently been subjected to great disturbance, before the waters of Licking commenced their cutting and disintegrating process through its rocky bed. These sandstone rocks contain very few fossil plants, but when fairly without the line of the coal measures, they abound in fossil shells, very similar to those found in the lime rocks of the older secondary formations. The cliffs are lined with evergreens of various species, amongst which I noticed the hemlock, red cedar and yellow pine. On emerging from the ravine,

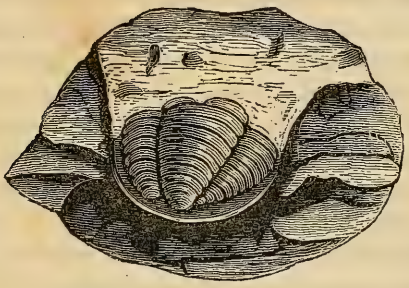
which is done by means of a natural channel, cut by a small stream, the canal passes over the wide and fertile alluvions of the Licking valley. The crab apple is now in full bloom, and at short intervals perfumes the air with its delicious fragrance. Fields are planting with Indian corn, and in some warm and sheltered spots, it is already two inches high. We reached the town of Newark, at 8 P. M.

Newark, May 19th.—Newark is the seat of justice for Licking County. It is a place of considerable commercial importance. The canal passes along one of its principal streets, and by moonlight reminds one of some of the towns in Holland. The present number of inhabitants is said to be about eighteen hundred, and is rapidly increasing. In the centre of the town is a large public square, in the midst of which stands the court house. This square, when enclosed with a railing, and ornamented with our native forest trees, will make a fine promenade, and add more than any thing else, to the credit and the beauty of the place. A town without trees is altogether too artificial, either for health, comfort, or good taste. The new Episcopal church, now nearly finished, with its buttresses, battlements, and high gothic windows, is quite creditable to the projectors, and an ornament to the town.

Rock Strata.—I made an excursion to-day with a friend, for the purpose of examining more closely than my hasty view of yesterday would allow, the character of the rock strata at the narrows of Licking, distant nine miles from Newark. Several quarries are now opened, and with the excavation to form the tow-path, give a fine view of the order of superposition. So far as accessible, I find it very similar to that of the falls of the Cuyahoga, and of the same character with that of the chain forming the western and northern termination of the coal measures in Ohio. A loosely cohering, coarse aggregate, or pudding-stone, composes a deposit twelve or fourteen feet in thickness, about midway to the tops of the cliffs; above which is a coarse sandstone, splitting easily into large blocks for architectural purposes. Below this conglomerate, or pudding-stone, is a deposit of finer grained rock, *tinged highly with red* in many places, but it has not been exposed to a sufficient depth to disclose the *true red sandstone*, which, judging from the character of the fossil shells, found a little farther west, and high in the hills, I have no doubt will be found here. I could discover no traces of coal, nor any fossil plants belonging to the coal series.

Trilobites.—In examining, a few miles west of this place, in the same range of hills, the fossil contents of a rock, which is fine grained, but rather loose in texture, and tinged brown with the oxide of iron, I discovered, in a few minutes, no less than three imperfect and broken Trilobites, which are the first I have seen in place in the valley of the Ohio. A drawing of the most perfect specimen is given at Fig. 13. Portions of the abdomen are most common.

Fig. 13.



Description.—Breadth, one inch; length, about one inch and a half; diameter, half an inch. Tergum or intermediate lobe thick; one third thicker than the flanks, and more convex. Lobes deeply sculptured or furrowed, the whole of which are equal in size in all the lobes; encircled at the base with a flat horizontal zone, one eighth of an inch wide. Coated with brown oxide of iron, as are most of the reliquiæ of this deposit. No thorax or head found. The Trilobites are in company with innumerable relics of radiated Encrini, and thin, delicate, fine rayed Producti, similar to those found in the vicinity of the transition limestone, near the hot springs in Bath County, Virginia. Some very large and perfect Spiriferi, more than two inches in width, are found in the more compact and deeper seated deposit below. They are more deeply grooved and stronger marked than those from "Flint Ridge." I have also a very perfect bivalve from the same locality, which looks like a small, elongated Mya. As we descend deeper towards the base of the hills, these remains become more rare, the rock is finer grained, of a rich brown color, and furnishes a beautiful material for tomb-stones and chimney-pieces, and other ornamental work. The finest variety is singularly spotted with small dark specks, all through the stone; it looks, when polished, as if it had been sprinkled with some dark liquid stain. It is a very curious fact, that a similar rock is found in Illinois, near

the Mississippi River; it is so much like this that one can hardly be distinguished from the other. I have specimens of both in my cabinet. These deposits, destitute of vegetable remains, would seem to indicate the western termination of the coal series.* The deposits north and west are evidently tertiary, resting on the older secondary, filled with bowlders of the primitive rocks and broken relics of the secondary series—in some places encroaching on the coal measures, as at the falls of the Cuyahoga, and again receding to the west, like the bays and headlands on a rocky coast. Another indication of a change in the deeper deposits, similar to that on the south east side of the coal measures, is the formation of mineral springs. While none are found of any magnitude or mineral strength within the great sandstone and coal basin, they are very abundant on both the north and south sides of it, in the magnesian and transition limestone series, which are known to prevail in these regions.

Delaware Sulphur Springs.—In Delaware County, about thirty five or forty miles north westerly from Newark, are found several sulphur and ferruginous springs. The most noted of these is the White Sulphur, in the town of Delaware. From the midst of limestone rocks, filled with marine shells and Encrini, similar to those found in the valley of the Greenbrier, (Va.) it issues in a stream of considerable volume, and discharges such quantities of sulphuretted hydrogen, as to be smelt at a considerable distance. As the gases leave the water, a precipitation of lime and sulphur takes place, in such abundance as to incrust sticks and stones lying in the course of the current with a white coat, similar to the White Sulphur water near Lewisburgh, Va. It is celebrated for the cure of similar diseases, and is fast rising into notice, for its valuable sanative properties. The following analysis, made last spring by Dr. Michell, professor of chemistry in Kenyon College, will show how near it approaches to those celebrated waters.

Analysis of the Delaware Sulphur Spring.—"One wine pint of the water, taken immediately from the spring, contains of

* Six miles west of Newark, at Granville, in the same fine grained sandstone, fossil bones of animals have several times been found by quarry-men. I have not seen any of the specimens, although I have made application to procure some of them, but have the statement from such a source as to satisfy me of its truth. This rock is, geologically, below the coal measures—passing under that formation—and may contain the Sauroid fishes of Agassiz, if not the Saurian reptiles.

Sulphuretted hydrogen gas, - -	12	cubic inches.
Carbonic acid gas, - - - -	3	do.

"One hundred grains of the deposit which results from the evaporation of several gallons of the water, yield on analysis, of

Muriate of soda, - - - - -	48	grains.
Muriate of lime, - - - - -	20	"
Sulphate of magnesia, - - - -	16	"
Sulphate of lime, - - - - -	8	"
Carbonate of soda, - - - - -	5	"
	97	"

"The above result shows that these waters approach as nearly to the well known waters of Aix la Chapelle and Harrowgate, as those do respectively to each other."*

These springs were first brought into notice as early as the year 1814, or more than twenty years ago, while the U. S. troops and militia were quartered in that place. In a written communication from Dr. Jackson of Clarksburgh, at that time a surgeon in the army, he speaks in high commendation of the valuable properties of those waters in curing the soldiers of visceral obstructions, consequent on intermittent and bilious remittent diseases, and also of herpetic eruptions, then very rife amongst the troops. He looks forward to the day when these waters will be esteemed a blessing to the inhabitants of malarious districts.

Sulphuret of Iron.—Previously to a late number of the American Journal of Science, I could never satisfactorily account for the immense quantities of sulphuret of iron, found in all our argillaceous, and many of the calcareous deposits. The beds of many streams, are filled with sulphurets of all forms and sizes, from minute grains to masses of several pounds weight. Not a well is dug in the uplands, but more or less of this mineral is brought up; and from its rich metallic lustre, it always leads the ignorant to believe that they have found a treasure. Animal remains of shells and bones are often changed to this semi-metallic state, specimens of both of which are in my collection. "Since gelatinous matter seems to have favored the conglomeration of silica, and consequently the formation of siliceous petrifactions; so likewise, the putrefaction of animal matter having produced sulphuretted hydrogen, if any particles of oxide of iron should happen to be present in the surrounding mud, pyrites would be formed and would accumulate about the places where the

* Gambier paper.

gas is discharged." How simply and beautifully this theory explains this formation of pyrites. This whole valley is one vast cemetery of animal and vegetable remains, and while the deposits were in a recent and plastic state, and the animal bodies inhumed, gradually decayed, the discharges of sulphuretted hydrogen must have been immense; and very satisfactorily account for the vast abundance of iron pyrites, found in many of our rock strata. From the decomposing pyrites, and the magnesian limestone rocks containing shells, these springs doubtless derive a large share of their mineral contents.

Having completed the examination of the rock strata at "the Narrows," we returned by a route more distant from the canal, across tertiary and alluvial plains. On these plains the crab apple finds a congenial soil and climate, standing in groves like the domestic apple, and perfuming the air with its delicious fragrance.

Iron Ores.—The belt of hydrated iron ore, noticed at Zoar, as crossing the state diagonally, on the outer border of the coal measures, here maintains its relation to the other deposits and lies near the top of the hills, imbedded in clay, in similarly large tabular masses. A few miles south of this place, we strike the siliceous deposit lying parallel with the ferruginous zone, and stretching N. E. and S. W. nearly across the state from Pike county to Stark. At its northern extremity, it widens out to nearly twenty miles, and stretches off into Holmes county. It does not uniformly lie on the tops of the hills, but crops out on their sides, with a thick diluvial deposit over it. The general course of the deposit, may be seen in the geological map of the coal measures, in the 29th Vol. of this Journal, but widening more at the north than there represented.

May 20.—We reached Zanesville at 6 o'clock, A. M., in the stage coach, passing over a moderately hilly and very picturesque region. The distance from Newark, is twenty eight miles; twenty two of which, are on "the national road," a work which is more creditable to the Republic, than the conquest of a continent. This road is in fine condition. The bridges, built on substantial arches, and crowned with parapets of sandstone, give promise of strength and durability. Americans are so much in the habit of building with perishable materials, not only their private dwellings, but their public edifices, that every attempt at permanency, ought to be noticed and encouraged. Along the distance of twenty two miles, no fewer than six villages have sprung up, since the location of the road in 1832. The wood lands over the last eight miles of the way,

wear a most enchanting appearance. The soil is so very congenial to the growth of the Cornus florida, or dog wood, that these trees vegetate in countless numbers, and being now in full bloom, their clear white petals, are finely contrasted with the deep green of the forest, and no cultivated orchard of fruit trees, ever displayed such an array of splendor and beauty.

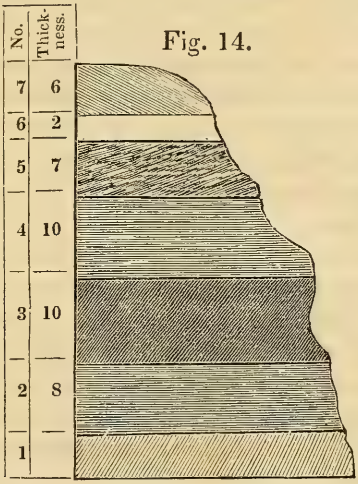
Fossil arborescent Ferns.—In the afternoon, I visited a deposit of coarse sandstone, three miles west of Zanesville, which is literally filled with the broken trunks and branches of various species of the arborescent fern and other fossil plants of the antediluvian period. I brought away several specimens, and amongst them is one species which still retains portions of the spines or setæ, that grew in the center of the scales which covered the surface and formed the cortical portion of these singular trees, so admirably fitted to the purpose for which they were apparently created, viz. that of furnishing an inexhaustible supply of fuel for man, when the present forests are removed to make room for the immense tillage that will, in time, be needed for the support of the teeming millions, destined to people the earth, when wars shall cease and diseases shall be greatly diminished, if not entirely banished. Buried deep under superincumbent strata, these ancient forests lie bituminized and changed to an imperishable material, in the form of "Stone coal!" How glorious and how wonderful the providence of the Creator, in the material, as well as in the moral world. The whole region about Zanesville, is full of interesting relics of by-gone ages; descriptions of many of which are given in a late number of this Journal.

May 21, "*Flint Ridge.*"—I visited "Flint ridge," or the great siliceous deposit, in company with my friend N. This interesting formation has been frequently noticed in former publications. Being desirous of obtaining a more correct knowledge of its relation to the other rock strata, with which it is associated, I visited the nearest locality to Zanesville, distant about twelve miles. The deposit is here found, as well as in other places, near the tops of the hills, sometimes entirely on the surface, covering large tracts with its broken fragments; at others, lying at considerable depths beneath a rich argillaceous soil and a luxuriant growth of forest trees. The spot chosen for the present examination lies in Hopewell township, Muskingum county, near the line which divides it from Licking county, on the extreme head of the Brushy fork of Licking creek; in the bed of a deep ravine. The siliceous rock is here hollowed out, by

the action of the torrents and wintry frosts, into a grotto of considerable size, called the "wild cat's den," from the fact of one or two of those animals having been killed here in early days. It will serve as a landmark for others who may wish to visit the place. From this spot I followed down the deep ravine of the run, a considerable distance, as far as I could conveniently go, the sides of which were very abrupt and gave quite a satisfactory view of the stratification. My examination ended with a deposit of yellow Ochre, in the bed of the run, which I shall make the first step in the section.

Section of Rock Strata at Flint Ridge.—Order ascending.

Fig. 14.



Bed of run or branch.

1. Argillaceous, slaty earth, resembling ochre in appearance; color, pale yellow; forming the bed of the run; depth, unknown.

2. Resting on the ochre, lies a deposit of slaty, light grey, sandstone, containing considerable white mica in fine scales; easily crumbling and decomposing when exposed to the weather.—8 feet.

3. Bituminous shale; below, with traces of coal; upper part of the bed, dark clay slate, considerably compact in places. The superior portion of the deposit, very fissile and highly calcareous, nearly black; containing numerous specimens of fossil shells, generally small terebratulæ and the upper or flat valve of the Productus, No. 12, figured on plate 2, Vol. 29 of this Journal. Many of these shells still retain the cuticle.—10 feet.

4. Light gray compact limestone; in some places mixed with silex; breaking into irregular conchoidal masses and containing or-

ganic remains of what appear to me to be Ventricolites, bearing a strong resemblance to those described by Dr. Mantell, in the flint or chalk Zoophytes of the south of England.—10 feet.

5. Resting on the calcareous rock, reposes the great siliceous deposit. At this place the upper part of the bed is very white and compact, containing however, many small Encrini. Below, it is of various hues, strangely diversified from a deep indigo, to green, yellow, red, horn color, &c. Near the superior portion of the bed it is more porous, contains a little lime and looks as if it had been traversed in all directions, by small worms, leaving brown colored passages of the size of a common pin. This is the portion chosen for the construction of mill stones; and when properly selected, affords an excellent instrument for the manufacture of flour. I received this summer, a specimen of cellular quartz, from the shore of the Mississippi, in Calhoun county, Illinois, containing a large and very fine Spirifer cameratus, similar to those found here; proving the habitat of this shell to have been widely extended over the bed of this ancient ocean.—7 feet.

6. Resting on the uper surface of the main siliceous rock, is a deposit of a much more loosely cohering calcareo-siliceous material, containing considerable iron, and resembling bog ore, being probably the remains of the mineral matter held in solution by the warm water of the ocean, after the more siliceous portion had been thrown down. That this was actually the fact, is more than probable from the irregular and diffuse manner in which this deposit rests on the other strata, being confined to a narrow belt of only a few miles in width; it must have been discharged from the bowels of the earth through a fissure in the bottom of the ocean, opened by the force of internal heat, and the expansive power of confined gases, and gradually precipitated in the vicinity of the opening, which on more minute examinations, I doubt not may be accurately traced.—2 feet.

7. Above this is a deposit of rich yellowish, argillaceous soil, once covered with a heavy growth of forest trees, but now under cultivation. The siliceous rocks abound in fossil shells, affording presumptive evidence of the assumed fact, that they lived and propagated in the bed of the ocean for many years after the precipitation of the siliceous mud; and that they finally perished and became silicified after and during the period of the change from water to dry land. The genera and species are, many of them, similar to those found in the upper calcareous rocks at Zanesville; and figured and described

in the "section of Putnam hill." I procured and brought away, a number of beautiful specimens, some of which were replaced by chalcedony, and quite translucent.

Cannel coal.—Six miles west of this place, in Licking county, but still in the siliceous deposits, there has been recently discovered a fine bed of *Cannel coal*, similar to that near Cambridge, in Guernsey Co. Ohio. I did not visit the place myself, but have no doubt of the fact; an intelligent friend assuring me he had specimens from that spot. These deposits having been subjected to a very considerable degree of heat, would be the proper place to look for cannel coal, as this species appears to be the common bituminous coal, reduced to a pasty or semi-fluid state by heat after it was deposited. Its fracture is similar to that of a vitrified substance, highly conchoidal.

This region has been a favorite spot with the aborigines; large heaps of fragments are found where arrow heads had been manufactured. Many of these pieces are of the first quality for gun flints, and are much prized by the neighboring hunters. Mounds are also common; a very large one near this place is constructed of sandstone, made up of fragments of such size as a man can conveniently lift. It is at least sixty feet in diameter at the base, and fifteen feet in height. The mound is the more interesting, from the fact, that no sandstone is found on the surface, within half a mile of it. The flint rocks were perhaps, considered sacred and too valuable to be applied to such a purpose, although covering the ground. Large springs of very pure water are common in this formation. After returning to Zanesville, I visited the coal beds and examined the stratification of "Putnam hill."

Cabinet of the Atheneum at Zanesville.—May 22: I passed the day in examining the cabinet of the Atheneum. It contains a number of very interesting remains of the gigantic mastodon; consisting of molar teeth and large portions of the tusks. A number of rare fossil shells, amongst which I noticed Ammonites Hildrethi and Pholadomya elongata, with the undescribed bones of some extinct animals, several of which were found in excavating the Ohio canal, in a peat swamp, two miles north of Nashport, in the deep cutting between the valley of the Muskingum and the Licking, on Wakitomika Creek. The mud in this swamp was very deep and of a thin fluid character, similar to that of some of the bogs on the sides of the mountains in Scotland. It occasioned much trouble and expense, crowding in laterally at night a quantity equal to all that the workmen could throw out by day; it was finally overcome by a frame work of tim-

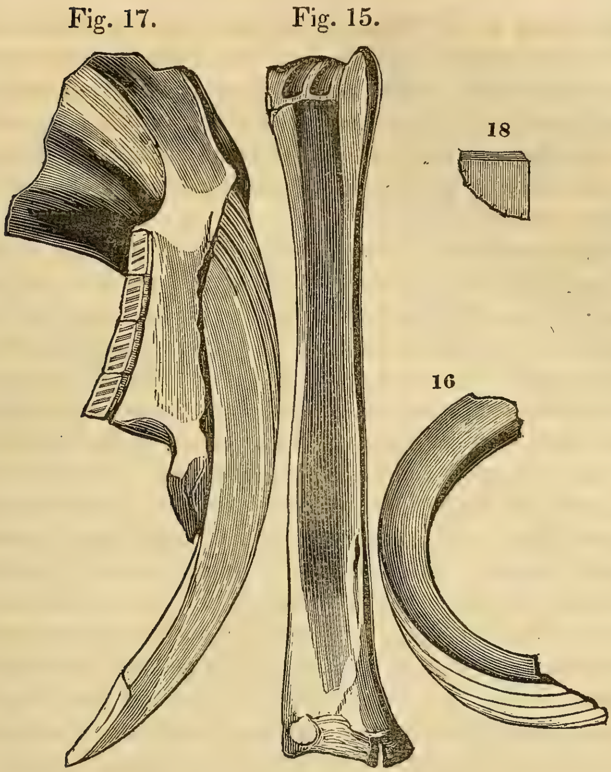
ber and planks, until the sides of the canal were built up and secured, with gravel and earth.

The fossil head of the animal which belongs to the order Ruminantia and probably to an extinct species of the genus Ovis, was found at the depth of eight feet in company with two others, near it. The bones of the mastodon, and the right halves of the lower jaws of two extinct animals of the order Rodentia, or Gnawers, with a radius or bone of the fore arm, were found at the depth of fourteen feet, resting on a bed of pebbles and gravel. They were safely preserved from decay by the black carbonaceous mud under which they lie, but had been considerably worn by attrition, before being deposited here, which might have been at the same period, and by the same catastrophe which covered the districts north and west of this with primitive bowlders. One of the heads of the Oves, and one of the half jaws of the Rodentia, are now in the cabinet of the Atheneum. The drawings of these relics are of one fourth the natural size, and will assist the reader in understanding the descriptions which I shall attempt to give.

The radius or bone of the fore arm.—Description.—Ten inches in length, two inches across the head, and one and a half inches across the carpal extremity, with a strong process on the outer side. A moderately elevated longitudinal process runs nearly the whole length of the bone, with a profound groove beside it. From the thickness of the bone in proportion to the length, I should infer that powerful muscles had been attached to it. Fig. 15.

Upper Incisor.—This tooth is very much curved, embracing the larger portion of a semicircle. Measuring on the outer margin of the tooth, it is eight inches in length; but being broken and shortened at both the cutting and radical extremities, it must originally have been not less than ten or twelve inches. Diameter, seven eighths of an inch. A section of the tooth is nearly triangular, as shown at Fig. 18, with the two inner faces plano-concave, and the outer face rounded and *deeply grooved.* Fig. 16.

Lower Jaw.—The maxillary portion of the jaw, is eight inches long, and four inches wide across the articulating portion. The condyloid process is broken and gone. *Molar teeth.*—The molares are four in number, standing obliquely to the line of the alveolar process. The grinding surface of each tooth is channeled, in the manner of ruminating animals, five eighths of an inch in diameter, with the front tooth a little longer than the back one. They are firmly placed in the jaw for grinding hard ligneous substances.



Figures one fourth size.

Inferior Incisor.—The lower incisor is much less curved than the upper, and is longer than the whole jaw, being no less than nine inches in length and one inch in diameter. The two inner surfaces are smooth and plano-convex, while the outer surface is deeply grooved, and the whole is coated with a dark brown glossy enamel. It is strongly inserted into the jaw opposite the last molar tooth, passing under them all. The cutting extremity is trenchant and beautifully fitted for cutting wood or bark. Its left inner surface for two inches near the end is considerably worn, from friction with the upper incisor. The muscular impressions are very profound, giving proof of great strength in the jaw and the head to which it was attached. Fig. 17.

Remarks.—This animal was doubtless a Gnawer, perhaps of the Beaver family; or from the grooved outer surfaces of the incisors,

a marine animal of the Walrus or seal race, and a borderer of the ancient ocean. Since my return from Zanesville, I have received the larger portion of a similar tooth, imbedded in dark colored carbonate of lime. It was found on Wills Creek, near the lias deposits, about forty miles east, and had fallen out from a calcareous rock which lies near the tops of the hills, one hundred and fifty feet above the bed of the creek.*

Head of fossil Ovis.—Description.—The whole head is much rounder and fuller than the domestic sheep. Breadth of os frontis between the eyes, three and a half inches: orbitary processes very prominent and one and six eighths of an inch in diameter: space between the horns, two inches at the base, which incline backward at an angle of about sixty degrees. Base of the head, measuring from occipital hole, to nasal extremity, eight inches, a part of which is broken off. Six stout molar teeth on each side; a mamillary process on each side of the upper maxillary bones, one third of an inch high, with broad base, opposite the second molar tooth, counting from back forward. They are probably the supports of a fleshy substance for the growth of tufts of long hairs. Palate bones slightly arched. The medullary portion of the horns now remaining, is two inches long; thin on the upper side, and one inch thick on the under, and one and a half inches deep. From their direction, they were probably more like goats' horns than those of a common sheep. The animal differed from the domestic sheep in the following particulars. In the domestic animal, the space between the horns is much less; between the eyes, the distance is also less. The eyes themselves are considerably smaller, and there is no mamillary process on the maxillary bone, which is the strongest mark of a specific difference between the modern and the ancient races. It may be named Ovis mamillaris. Fig. 19, gives a view of the head.

Fossil Chiton.—Description.—Length, eight inches; breadth, six inches; nearly cordiform in its outlines, and fully one inch in thickness on the lateral margins. Back slightly convex. Shell, with ten valves; longitudinally arranged and finely united on the back of the animal, somewhat resembling spinal articulations. Surface of each valve, smooth, or very slightly striated, and distinctly

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* In excavating the new canal this summer, in the deep cutting between the heads of Sandy and Beaver Creeks, many fossil bones were found. Among them, I am informed by J. Pierce, Esq., are some similar to these, but more than three times as large.

Fig. 19.—Side view of the head of fossil Ovis, reduced.

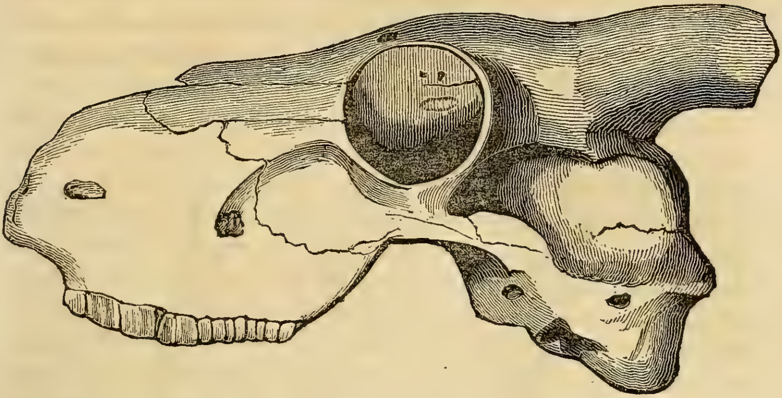
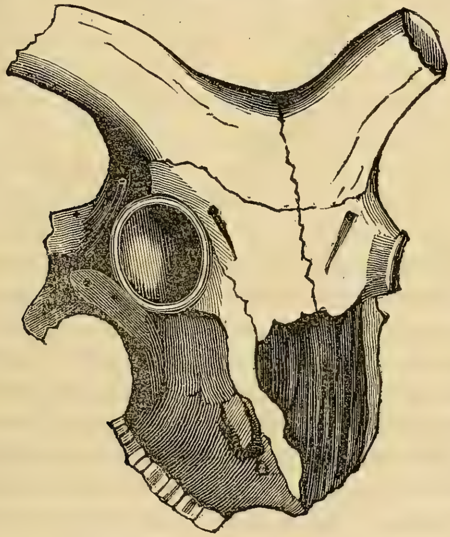


Fig. 19.—Front view of the head of fossil Ovis, reduced.

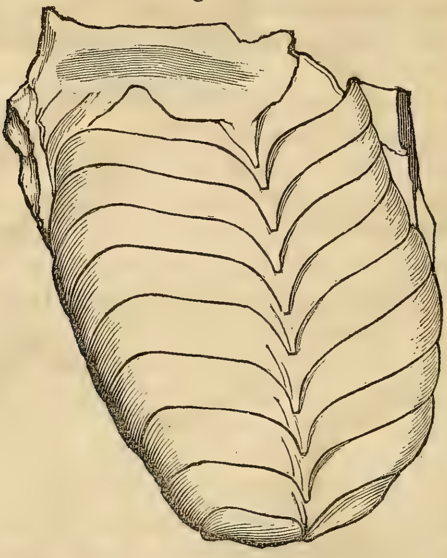


marked with a very plain suture. Margin, smooth. The dermoid portion is replaced by a beautiful, greenish colored, crystalized carbonate of lime, about one line thick.

Remarks.—This beautifully preserved fossil animal, was found a few days since, imbedded in a dark carbonaceous lime rock, which forms the bed of the Muskingum river, a short distance below the falls. In splitting the rock, the back of the animal was distinctly disclosed; the abdomen is yet buried in the fragment. The outlines are very perfect, showing the back and sides very distinctly. This

fossil so much more resembles a Chiton, than any of the family of Asaphi, that I have ventured to name it, Chiton occidentalis, until some one more appropriate can be found. Fig. 20, one fourth size.

Fig. 20.



May 23.—I left Zanesville at early dawn, in the stage coach for Marietta. The environs of Zanesville, are picturesque and beautiful, affording many fine views of scenery. The whippoorwill or Caprimulgus vociferus, was chanting his monotonous matin hymn, and ever and anon, the mocking bird added his cheerful and varied notes. A striking change has taken place in the progress of vegetation within a few days, especially from that of the elevated table lands on the heads of the Muskingum, where many of the forest trees were yet destitute of foliage. We reached Chandlers, the site of an ancient saline, to breakfast. At the first settlement of the country, before salt wells were in use, the inhabitants were in the practice of assembling in parties of six or eight, and with their domestic kettles make a scanty supply for their own use, from the saline water as it arose from the earth near the bed of Salt Creek, a good sized millstream, which discharges its waters into the Muskingum, about ten miles below Zanesville. The Anona glabra or papaw, and Prunus virginianus or black cherry, are both in bloom. Rye is in head, ready to blossom, and Indian corn just above ground. We reached Marietta at 8 P. M. after an absence of eighteen days.

Art. II.—*Notice of the Aurora Borealis,* of April 22.*

We had the good fortune to witness, on the night of the 22d, and morning of the 23d of April, a most magnificent display of northern lights. This phenomenon is but rarely seen in our latitude, and more rarely still, appears to us in its highest splendor. As accurate a description, therefore, as may be given of its late remarkable appearance, with a statement of such facts, as may tend in any degree to elucidate the questions which it presents, cannot be unacceptable, and may prove useful. I begin by noting the state of the weather at the time; although I am not aware that the Aurora either influences it, or is affected by it. The day was fair during the whole of the 22d. A high wind blew from the north-west until mid-day, when it became calm. At night fall, the wind again arose, and increased gradually so as to be moderately high by two o'clock the next morning. At dusk it had shifted to the west. The temperature was 39° at sun-rise of the 22d, and 53° at three o'clock, P. M. From ten o'clock that night until two the following morning, the thermometer stood at 38°; the barometer remained stationary at 30.00 throughout the evening and night.

About seven o'clock on the evening of the 22d, it was noticed that a large part of the northern heavens was covered with a thin vapor-like appearance—white at the base—of a pale red at the upper edges, and of a deeper hue, red and yellow intermixed, about the middle. It spread through an arc of sixty degrees near the horizon, and extended half way up to the zenith. Before nine o'clock it had disappeared, leaving nothing but a bank of white Auroral vapor, stretching along the north and north-east horizon. At fifteen minutes after ten, on looking towards the north, I perceived a few well-defined columns, shooting up a short distance, each of them appearing and vanishing momentarily; yet so that to a careless observer, they might seem to remain permanently before the view.

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* To Professor Silliman, Yale College, New Haven.

Dear Sir,—The following account of the Aurora Borealis of April 22d, as it appeared at this place, was lately made at the monthly meeting of a Scientific Association, the members of which have requested me to forward it to you, for insertion in your Journal. If you think it sufficiently interesting, you will oblige me by giving it a place in your next number.

I am, respectfully, your obedient servant, J. McCaffrey.

Mt. St. Mary's College, Emmitsburg, May 18th, 1836.

Some of my friends were now called up to enjoy the spectacle, and subsequently all the Professors and Tutors, and many students of the College, were witnesses of the phenomena. Gradually the northern streams increased both in number and in length, as new ones sprung east and west of those originally observed. Stars could be seen dimly shining through them. The color of these coruscations was of a bluish white near their base; farther up it was of a brighter and more silvery hue. Those nearest the moon, which was then in her first quarter and gave a strong light, assumed for a very short time a pale green, then a bright orange color; and one, which shot up to a great length, became particularly remarkable by its brilliant redness. The whole scene was still farther enlivened by a beautiful play of crimson light gracefully undulating upwards along the streamers. The long rays continued to shoot up higher and higher, until they all converged at a point on or near the meridian, about midway between Arcturus and β Leonis. The right ascension of the focus, was found, on reference to the globe, to be 194° 20′, and its declension, 18° north. It is not, however, pretended that its position was determined with perfect accuracy. At this point, the streamers which magnificently decorated the whole northern hemisphere, reddening as they converged, formed a superb oval crown of deep crimson light. This crown, which seemed like a lake of blood, extended, east and west, about fifteen degrees, and ten or twelve in the opposite direction. It had such a preternatural aspect, and, viewed in connexion with the accompanying phenomena, one of such overpowering sublimity, as to inspire a profound feeling of religious awe. It lasted from five minutes before eleven o'clock, until five minutes after. Gradually the redness faded away; the coruscations, which had lately met and mingled in the color of blood, no longer entirely converged; around the focus was left a blank space of very irregular outline; south of it were seen the broken off extremities of the most northern rays; while all the rays near the convergence, had a peculiar brushy appearance. At later periods, the point of convergence, as well as it could be determined, was found nearer and nearer to Arcturus, indicating that the whole meteor moved with the earth. During the more brilliant stages of the phenomena, the stars looked very dim; and the moon, previous to her setting, shorn of more than half her lustre, had a sickly, pallid aspect. For the space of two hours after the disappearing of the Auroral crown, the illuminated portion of the heavenly dome

exhibited in great brilliancy and variety, the phenomenon fancifully called the "Merry Dancers." It was the incessant play of a flickering light, not so bright as the Vespertine, which in some respects it resembled, glancing about in various directions, but chiefly towards the zenith, over this vast expanse. Its motions were far too varied and fantastic, to admit of description. In general, one flash seemed to chase another, as they arose in graceful undulations, or rather darted up the sky, along and between the white Auroral columns. At half past eleven, the spectacle began to lose its attractive brilliancy. Still later, the luminous rays were intersected by two irregular belts of white vapor, which appeared successively in the north and north-east, one of them spanning an arc of about thirty, the other of forty or forty five degrees. There were a few other nebulous masses of the same substance, but of less extent. About twelve o'clock, the Merry Dancers renewed the splendor of their exhibition, and continued it with less and less brilliancy for an hour. Between eleven and twelve, a dark cloud had arisen in the northeast; before two, the wind was blowing from the south, and the sky was so far overcast as to hide completely from our view all that remained of that magnificence and splendor, on which we had gazed for hours, and would willingly have gazed at much longer.

The magnetic needle was observed to oscillate during the phenomenon. Its perceived variation was forty five seconds westward; but we have reason to suppose that a greater variation might have been detected, had we been able to ascertain it with more perfect accuracy.

The morning of the 23d was cloudy, with a very high southeast wind. The thermometer at sun-rise, stood at 42°, the barometer at 29.98. It was fair at noon. At three o'clock, P. M. the thermometer indicated 62°, the barometer 29.83. The wind had now fallen, and a perfect calm ensued. At half past eight, P. M. of the same day, a streak of red light was seen towards the north. Later, there were a few other faint indications of an Aurora; but the hopes excited by them were disappointed.

Art. III.—*On Definitions;* by Rev. D. Wilkie, of Quebec.

No. III.

From the observations already made on this subject, it must evidently appear that the terms employed in treating of moral subjects do not admit of accurate logical definitions. The only means that one man possesses of knowing what are the feelings of another man, are by judging of causes by their effects, and of effects by their causes. In either case, the feeling itself is unknown to us, and perceptible only to the sentient being himself. We infer that like causes produce similar effects in him, and in us, and that like feelings lead to similar effects and similar expressions in him and in us. We have had experience that the prospect of good, of some advantage and happiness, affords us the pleasant feelings of hope. We infer that it produces the same effect in him. We know the animated and lively expressions of joy which it led us to use. If we see the same lively and animated conduct on his part, we attribute it to the same cause; and are especially confirmed in this opinion, if we know that a similar cause existed to produce it.

Still these inferences possess less or more the nature of conjectures: the feeling itself remains forever unseen, but to the man himself who has it. Mankind neither see it, nor can see it. They can judge of it only by its effects, or by its causes.

Besides we know in fact, that the feelings of mankind are widely different on the same subjects. They are similar, but widely different in extent. There must always, therefore, exist some degree of uncertainty as to the names given to the feelings of the mind. We may approach to strict definitions, but cannot obtain them with perfect accuracy.

Hence it is, that all moral rules have a certain latitude, and must be applied according to circumstances. If we examine any of the most celebrated maxims of antiquity, or any of the best moral rules laid down by the moderns, we shall find that there is scarcely one of them, perhaps not one, which does not, in certain circumstances, give rise to doubt, mistake, and disputation. The general course of human life, it is true, is governed by rules which are clear and precise. But there are situations in which the application of every rule that can be devised becomes doubtful and uncertain.

One of the maxims handed down from the early ages of the Greeks, said to have been first delivered by Pittacus, was (Γνῶθι καιρὸς, occasionem cognosce,) *observe, or act according to the occasion.* This maxim, if fairly interpreted, seems to imply, that our conduct and behavior ought to be suited to the occasion before us, that is, in fact, to the circumstances in which we are placed, which circumstances, are indeed the very causes why we are required to act. It is impossible, therefore, that any advice can be more proper, or more salutary, if fully acted on. Yet, by a very slight change in the mode of viewing the precept, it may be understood in a totally different sense; it may be considered as sanctioning the practice of a time-server, the most despicable of all characters, as studying to render every change of circumstances, by every means in his power, subservient to his immediate and personal interests.

The more celebrated maxim, (Γνῶθι σεαυτόν,) *know thyself,* appears much less exceptionable, and is perhaps less liable to misconstruction than any rule that can be given. Yet even this has been found subject, or at least, thought to be subject to misconception. How often is it observed of persons of either sex, that they would be better characters, that is, more observant of their moral duties, if they knew less of the superiority of their personal qualities? This is one aspect in which the precept would seem to be wrong, though in reality the error is only apparent; for the knowledge which is blamed, or thought hurtful in such persons, is only a partial knowledge of themselves, and its ill effects would be entirely obviated by a fuller acquaintance with every thing that can be comprehended under the complex term, themselves.

No rule in morals is of more extensive application, or more useful in practice, than that which requires us to hold sacred the property of another. The general application of this rule is obvious and extremely easy. Yet no rule has given rise to such innumerable questions, and we daily see hundreds of disputes arise out of this subject, which give occasion to the most serious contestations, and which nothing but superior authority, joined with superior knowledge, can decide. Many of the questions that arise out of this very general rule, are of so vague and intricate a nature, that nothing but an arbitrary rule, applicable to all the cases that fall under it, can serve the purpose of guiding the actions of mankind in regard to them. For example, whether the property of any literary work or invention, shall continue to be the author's or inventor's, for

twelve, or fifteen, or twenty, or fifty years, is a question which cannot be settled but by some positive enactment on the subject. And even when this is done, the subject is still sufficiently vague and indefinite to give rise to numerous questions, to many doubts, and a great deal of litigation as to the right of authorship and prior invention.

These examples will be sufficient, it is hoped, to explain clearly what is meant by the general assertion already and repeatedly made, that moral science does not admit of strictly logical definitions. This assertion was proved in the previous part of these observations, in which it was shown that morality was occupied with invisible objects, which could not be brought before the eye, or any of the senses, for the purpose of verifying to each other's satisfaction, the use which we make of the terms employed. The examples now adduced, serve also to illustrate the consequences of that incapability of strict definition, the partial uncertainty of all discussions of this kind, the possibility of being misunderstood in every statement of a moral nature, and the extreme degree of care that is necessary in the use of every term which we employ.

No human science can be compared in importance with morals, since upon this depends all the happiness of men, whether considered as individuals, or existing in societies. It is impossible to express in too strong terms, the infinite importance of acquiring accurate conceptions of the ideas involved in the various terms which it employs, as well as of adhering in our own use of these terms, to the most strict and logical definitions that can be obtained. Nothing is so much to be deprecated as a loose and careless use of terms, in this, the most important of all sciences. The conduct of individuals cannot be expected to be correct and consistent, while their ideas of their duty are wavering and uncertain. Still less can the conduct of nations and societies be strictly conformable to justice or to their own interest, while the moral conceptions of those who direct them, are fluctuating and ill founded. Numberless disputes, also, which have divided and embittered the sentiments of mankind, would have been prevented or soon removed, had those who entertained them, had an opportunity of coming to a mutual understanding respecting the terms employed in the expression of their opinions. And it cannot be doubted, that the total want of reflection on that uncertainty which we have shown to be inherent in the origin of our moral sentiments, has been a fruitful source of that fearful intolerance which has marked so many ages of the history of man.

The observations which have been made upon moral definitions, are in all respects, applicable to intellectual ones: But the subject is of much less importance, as for the most part, persons only possessing some degree of education, are interested in questions of this description; while moral discriminations are in use among all mankind, and are employed by them during every waking hour of their lives.

I proceed to make some observations on the use of definitions in those branches of human knowledge which are conversant, partly in visible, and partly in invisible objects.

Grammar, rhetoric, and criticism, together with every thing relating to the theory and practice of language, are conversant in objects perceived by the senses, namely, words; but many of these words are the signs of invisible objects, and therefore bring us back to the principles already explained, for judging of things unseen by their causes, or by their effects.

In these departments of knowledge, the best definitions that can be given, are for the most part imperfect, and, in many cases, vague. By a beginner in these studies, they can never be understood without numerous examples, and much practice is necessary for their full development.

In grammar, for example, no writer has hitherto been able to produce a satisfactory definition of the very common word Verb, though that is one of the most important in the list of grammatical terms. No definition of that part of speech can be given which does not exclude something which that term ought to contain, or which does not contain something which it ought to exclude.

A noun is defined by the best writers on grammar to be the name of something: but the words *name* and *something*, are both so indefinite, that nothing but long practice can enable any one to understand thoroughly the definition.

Of all the definitions in grammar, none seems more simple and easy than that of a *pronoun*, which is defined, a word used instead of a noun. But numberless instances constantly occur, of nouns that are used instead of other nouns, which, by the definitions, would therefore, themselves become pronouns. Thus, instead of repeating a person's name, or the name of a place, we say, the person or place, mentioned before, or mentioned above. All such phrases by the definition, ought to be pronouns.

The terms employed in the higher departments of rhetoric and criticism, and all discussions on language are equally vague with those that have been mentioned, and equally incapable of strict definition. All such terms as figure, simile, personification, hyperbole, concise, diffuse, elegant, simple, sublime in style, prose, poetry, history, pastoral and didactic poetry, and numberless others of a similar nature, admit of no precise definitions. The ideas conveyed by them, run into each other like tbe colors of the rainbow, and cannot be precisely discriminated. We are not indeed, to suppose, that the use of these words and phrases, is always uncertain. Many of their applications, perhaps the greatest number of them, are accompanied with no uncertainty. But there are others in which their use will always be doubtful. There can be no difficulty in distinguishing an ordinary Epic Poem from a Tragedy or a Pastoral. But there are poems of which it is not easy to say, to what class they belong. And of some works written by eminent authors, there are disputes whether they are to be considered as prose or poetry.

One figure that we meet with, may be decidedly a comparison; but of another, we cannot tell whether it is a metaphor, or a prosopopeia, or an apostrophe. And when we come to determine the propriety of its application, we are still in greater difficulty, and must employ much analogical reasoning; we must appeal to the vague dictates of Taste; we must call up the feelings of the heart, which differ widely in different men. Who can define elegance in writing? Who can tell in what simplicity consists? Who can describe in what consists that nameless grace in so many favorite authors which all delight to peruse, which appear to all so easy to imitate, but which so few have the fortune to acquire the power of transfusing into their writings?

Since in *these departments of knowledge, the terms in most common use*, are so vague, and so little subjected to precise limitation, it can hardly be doubted that the whole system of precepts and speculations in these departments, possesses the same vagueness, the same antipathy to precise limitation and control. The whole of those speculations which are designated by the Belles Lettres, Criticism and Literature, as far as they consist of judgments upon the performances of Literary Authors, are made up of appeals to the feelings of the heart, and are more or less just, according to the power which the writer possesses in embodying his own feelings, or in first observing, and then of embodying those of others.

Those parts of this extensive department, however, which fall under the general denomination of Grammar, have, for reasons which will presently be seen, been reduced to a more definite form. The rules of Grammar are all arbitrary, for the subject admits of no other; and they resemble the arbitrary rules, laws and statutes of the Jurist; while the precepts and directions of the Critic, are, as Dr. Smith justly observes,* like the ethical maxims that enjoin benevolence and humanity. The former mark out for us a precise line; the latter, import general principles, but leave the precise mode of application to ourselves.

There are two reasons why the rules of grammar have, in all languages, been reduced to a precise form. The one is the vanity of man, the other is his necessities or his interest. Men are led by their vanity to seek and to study precise rules both of construction and grammatical pronunciation. When a person is introduced into a society whose language he but imperfectly understands, or understands without being able to practice with facility, his first awkward attempts to communicate his sentiments, are ungraceful, and attended with some degree of ridicule. However the polished part of mankind may repress this sentiment, it is undoubtedly natural and unavoidable. Even those who are well acquainted with a language, whenever, either from inadvertence or affectation, they deviate from the accustomed tones of pronunciation, or the usual forms of speech, they are received with some degree of contempt, or at least excite a smile. To avoid these inconveniences, to escape with greater certainty from the mortification of such situations, certain rules come to be followed, which, when they become considerable in number, are denominated the rules of grammar.

But whenever and however introduced, these rules are found to be not less useful than ornamental. They are found to serve a much higher purpose than at first supposed. They are found to be eminently subservient to perspicuity. From the view that has been given, it must evidently be originally a matter of no small difficulty to convey the sentiments of one man's mind into that of another. Nor is it ever done with perfect precision. To promote this important end, to convey our ideas with all the perspicuity that is possible, since it is never perfect, the best and most effectual means that can

* Theory of Moral Sentiments.

be followed, is to study fully the rules of grammar, and to practice them unremittingly. It is principally by its capability of serving this great purpose, that one language is considered as more improved, or more nearly approaching to perfection, than another.

It is of importance to observe that the art of grammar goes no further than to assist us in avoiding ambiguity. It furnishes no new means of conveying our sentiments. These the speaker or the writer must derive from that command over language, which his memory, his experience, and his associated ideas, give him. In this respect, the art of grammar is on a par with the art of criticism. The latter can only teach the poet or the orator to avoid errors. It creates no new faculties; it imparts no new powers. It simply directs, and guards from more glaring errors, those powers which nature has bestowed. Every practitioner in these elevated arts, and the connected ones, must seek for the means of great performances, in the resources of his own mind, in the vividness of his conceptions, and the boundless extent of his associations.

To conclude, all the physical sciences may in time, and after great improvements, be reduced to the form of exact sciences. Morals and literature, from the nature of the subjects of which they treat, must, however improved, be for ever excluded from that class.

Art. IV.—*Chemical Analyses of Mineral Waters from the Azores;* by Charles T. Jackson, M. D.

No. 1. Four bottles of water, carefully sealed at the boiling temperature. *Mark*, "No strings on necks of bottles."

This water was taken from the centre of the Great Geyser, by Dr. Webster.

On examination, there appears to be a partial vacuum over the water, so that it has evidently been well secured, and the water does not contain any gas in solution. When uncorked, no odor is perceptible. The water is transparent. A few flocculi of siliceous matter separate on standing. Tested for free acid, by blue litmus paper, none discovered. Reddened litmus paper is turned blue, and turmeric paper brown by the water. Hence it contains a *free alkali*. A portion of the water, neutralized by hydrochloric acid, was tested for metallic salts, precipitable by liquid sulphuretted hydrogen, and by hydro-sulphate of ammonia,—*none* discovered. A por-

tion of the water tested for sulphates, gave a *white cloud*, with acetate of barytes. The water, tested for soluble chlorides by solution of nitrate of silver, an abundant precipitate of chloride of silver was formed. After separation of the chloride of silver, the water, with slight excess of nitrate of silver, being exposed to sun light, a dark reddish brown precipitate forms, indicating the presence of organic matter.

Sp. gr. of the water is 1.0022, pure water being 1. 5000 grs. of the water, evaporated to dryness in a green glass dish, left 8.25 grs. of solid matter, of a straw yellow color, and containing numerous brilliant scales of silicate of soda, and crystals of chloride of sodium. It was observed while the evaporation of the water was going on, that gelatinous flocculi of the hydrate of silica separated, and towards the close of the evaporation the whole mass became very gelatinous, and required great care to avoid loss of matter by projection from the vessel. The dry mass was 8.25 grs. in 5000 grs. of water, and on analysis, was found to consist of

Carbonate of soda,
Silicate of soda,
Chloride of sodium,
Silicic acid,
Sulphate of soda,
Boracic acid ? and Lithia, } a trace.

No iodine, bromine, lime or potash, discovered.

The quantity of silicic acid contained in 5000 grs. of this water, is 1.6 grs. It is retained in solution in the state of *silicate of soda*. When the soda is exposed to the air, it attracts carbonic acid, and the silica is deposited. It is a very remarkable water, and of great geological interest.

Analysis of Water, "from the reservoir into which the hot water rises." Mark No. 2, " three strings on neck."

This water is clear and transparent; has a ferruginous taste; a few bubbles of gas escape when it is uncorked. Tested by lime water, it gives a precipitate of carbonate of lime; by hydro-sulphate of ammonia, black precipitate of sulphuret of iron; and by ferrocyanate of potash, blue precipitate takes place. Acetate of barytes gives a white cloud of sulphate of barytes. Nitrate of silver gives an abundant precipitate of chloride of silver, and the supernatant

water turns black on exposure to sun light. The water, tested by a solution of acetate of lead, a white precipitate of carbonate of lead forms, but no sulphuret. From the above researches, it appears that this water contains carbonates, chlorides and sulphates, in solution, besides a minute quantity of organic matter. Sp. gravity 1.002. 5000 grs. of the water, evaporated to dryness in a green glass capsule, give 7.6 grs. of dry solid matter of a brown color, consisting of

Silicic acid, - -	1.5
Carbonate of iron, - -	0.9
Carbonate of soda, Sulphate of soda, Chloride of sodium, Organic matter, } -	5.2
Carbonic acid gas,	
	7.6

Boston, March, 1836.

Art. V.—*Chemical Analysis of Water from the Azores. Water called Aqua Azêda;* by Charles T. Jackson, M. D.

Two bottles, containing mineral water from St. Michael's, well corked and sealed. When one of the bottles was opened, a copious extrication of carbonic acid gas took place, accompanied by a very slight odor of sulphuretted hydrogen. Taste of the water is very agreeable, acidulous and brisk. When drunk, it is found to be slightly tonic and antacid. Tested with lime water, it gives an abundant precipitate of carbonate of lime. Its sp. gr. is =1.001. 5000 grs. of the water, evaporated to dryness, gave 1.4 grs. solid matter of a brown color, which yields on analysis,

Silicic acid, - -	0.25
Carbonate of iron, - -	0.30
Carbonate of magnesia, -	0.02
Carbonate of lime, - -	0.01
Carbonate of soda, Chloride of sodium, }	0.80
Sulphate of soda, - -	0.01
Carbonic acid gas,	
	1.39
	1 loss.
	1.40

A fresh bottle of the water was taken, in order to determine the quantity of carbonic acid gas, which it contained. 5,000 grs. of the water were introduced into a small retort, which it nearly filled, and it was then connected with a graduated receiver, and heat applied to the retort. Carbonic acid gas passed over abundantly. When it was entirely extricated from the water, it was found to exceed its bulk in the proportion of 6 measures of gas to 5 measures of water.

This mineral water is of a remarkable character, containing carbonates of iron and soda in solution, with silicic acid. It is a valuable tonic and antacid remedy. The silicic acid is in combination with a portion of the soda in the state of silicate of soda. I do not know whether the presence of this substance will influence the action of the water on the system, but it is probable the silica is deposited in the stomach, and becomes inert the moment the gastric fluid acts on the water. I have not been able to detect iodine or bromine in this spring. I should think it expedient to send the Aqua Azêda to this country and to England for medicinal use.

When I read the above papers before the Boston Society of Natural History, I had occasion to exhibit a specimen of this water, which was drunk by the members, all of whom agreed that it was superior to the Seltzer water, or common soda water of commerce. It is surprising to observe the tonic effects of a minute proportion of carbonate of iron contained in a mineral water. The presence of carbonate of soda and free carbonic acid no doubt assists in its salubrious action.

Boston, May 20th, 1836.

Art. VI.—*Notice sur la Vie et les Ouvrages de M. le Comte Lagrange;* par M. la Chevalier Delambre, Secrétaire Perpétuel de l' Institut Royal de France. (Lue le 3 Janvier, 1814.)

(Translated and communicated for this Journal by F. Furber, Boston, Mass. Concluded from Vol. xxx. No. 1. page 80.)

M. Laplace had arrived, by induction, to that important theorem of the invariability of the major axis, and of the mean motions. It insured the stability of the planetary system, and dissipated for ever the fear that some had entertained, viz. that the planets being continually attracted towards the Sun, must finally be precipitated on

this body. M. Lagrange had already arrived at a result of about the same kind, for the moon. We can doubt, however, that the proposition was true in all its rigor. M. Lagrange had demonstrated it directly, and without supposing the orbits nearly circular, but with neglecting the squares, and the primary products of the masses. M. Poisson has since extended the demonstration to quantities of the second order. It is presumed that he will extend it to products of all orders. As to the rest, what is already done, suffices to show us that henceforth all fear in this respect, will be very foolish and very chimerical.

The common method of integrating equations of planetary motions, had an inconvenience which rendered solutions almost illusory, that of arcs of circles increasing indefinitely with the time. In certain cases, the arcs could be expunged. M. Laplace had made upon this kind very important remarks, but grounded on a *métaphysique* too subtle to offer the clearness of a purely analytical demonstration. Lagrange perceived that on making vary arbitrary constants, according to the principles employed in the theory of particular integrals, we can always avoid arcs of a circle in the calculation of perturbations.

The question of trajectories, or of families of curves, cutting at given angles an infinity of other curves, all of the same kind, had busied all geometers, from Leibnitz and Bernouilli, until Euler, who seemed to have left nothing undone upon this question. Lagrange made of it a new question, by carrying it from simple curves to surfaces. It leads to an equation of partial differences, integrable only in the case where the angle of intersection is right.

We have presented only a very imperfect idea of the immense series of labors which have given so much value to the Memoirs of the Academy of Berlin, while it had the inestimable advantage of being directed by M. Lagrange. It is such of these memoirs as by their extent and importance, can pass as a great work, and yet they were only a part of what those twenty years had seen him produce. He had therein composed his *Mécanique Analytique*, but he desired that it should be printed at Paris, where he hoped that his formulas would be given with more care and fidelity. It was moreover running too great hazard to trust such a manuscript in the hands of a traveller, who could not feel sufficiently all its worth. Lagrange made of it a copy, which M. Duchâtelet took the trouble of remitting to the Abbé Marie, with whom he was much connected. Marie

replied in a manner worthy of the confidence with which he was honored. His first care was to seek a bookseller who would risk the undertaking; and, what we can now scarcely believe, he could find none. The newer his methods, the more sublime his theory, the less were they likely to meet readers able to appreciate them, and without detracting from the merit of the work, the booksellers were excusable for distrusting a market found limited to a small number of geometers spread over the face of Europe. Desaint, the boldest of all those who were applied to, consented to risk an edition only under a formal engagement, signed by Marie, to take on his own account, the remnant of the edition, if at the end of a fixed time, it was not entirely exhausted. To this first service, Marie added another, of which M. Lagrange was at last also sensible. He procured for him an editor worthy of presiding over the impression of such a work. M. Legendre devoted himself entirely to this painful revision, and found himself repaid for it by the sentiments of veneration with which he was penetrated for the author, and by the thanks that he received therefor, in a letter which I have had in my hands, and which Lagrange had filled with expressions of his esteem and gratitude.

The book had not appeared when the author established himself in Paris. Many causes fixed him there. We must not believe, however, all those that have been alledged.

The death of Frederick had introduced great changes into Prussia, and might cause still greater to be feared. *Les savans n'y trouvaient plus la même considération;* it was, therefore, very naturally that M. Lagrange felt anew that desire that had formerly led him to Paris. These causes, with the publication of his *Mecanique*, were quite sufficient. It is unnecessary to add to them those stated in many pamphlets published in Germany, and particularly by the secret historian of the court of Berlin. Never, during an abode of twenty five years in France, have we heard M. Lagrange utter the least complaint against the minister accused of having irrevocably displeased him, *par des mêpris et des degoûts, que par respect pour lui-même il lui était impossible de dissimuler.* We may suspect that Lagrange had sufficient generosity to forget or to pardon wrongs for which he had taken the only vengeance worthy of him, that of quitting a country where his merit had been forgotten. But when interrogated directly on this subject, by a member of the Institute, (M. Burckhardt,) he gave only negative answers. These indicated no

other cause than the misfortunes that were believed ready to fall on Prussia. M. Hertzberg was dead. M. Lagrange, now a Count, and a French Senator, had no interest in dissembling truth. Thus we must refer to his constant denials.

The historian whom we have cited, was then misinformed. But the spirit of reviling and of satire, which so justly made his work suspicious, ought not to hinder us from quoting from it the lines wherein he sets forth, with all the energy which is peculiar to him, his own opinion, which is that of all Europe, where he does justice to M. Lagrange.*

"Il me semble," these are his terms, "qui il y aurait ici en ce moment une acquisition digne du roi de Frances. L'illustre Lagrange, le premier géomètre qui ait paru depuis Newton, et que, sous tous les rapportes de l'esprit et du genre, est l'homme qui m'a le plus étonneé; Lagrange le plus sage et peut-être le seul philosophe vraiment pratique qui ait jamais existé recommandable par son imperturbable sagesse, ses mœurs, sa conduite de tout genre, en un mot, l'objet du plus tendre respect du petit nombre d' hommes dont il le laisse approcher, Lagrange est mécontent, tout le convie à se retirer d' un pays ou rien n' absout du crime d'être étranger, et où il ne supportera pas de n' être pour ainsi dire qu' un objet de tolérance. . . . . . Le prince Cardito de Caffredo, ministre de Naples à Copenhague lui a offert les plus belles conditions de la part de son souverain : le grand duc, le roi de Sardaigne, l' invitent vivement; mais toutes leurs propositions qui lui sont faites, pour attendre les nôtres. J'ai oublié de vous dire que l' ambassadeur, (de France,) avait, à ma priere, addressé à M. de Vergennes la proposition d' appeler M. Lagrange."

The author whom we quote seemed to fear the opposition of M. de Breteuil. According to Lagrange himself, it was the abbe Marie who proposed him to M. de Breteuil; and this minister, that on all occasions met the wishes of the Academy of Sciences, favored this demand, and caused him to be agreed upon by Louis XVI.

The successor of Frederick, although moderately interested in the sciences, yet had some scruple in letting go a savant whom his predecessor had called, and whom he honored with peculiar esteem. After some steps, Lagrange succeeded in being permitted to depart, with the condition, however, that he would still give many memoirs

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* Secret History of the Court of Berlin, 1789. Tome II, p. 173, et suiv.

to the Academy of Berlin. The volumes of 1792, 1793, and 1803, prove that he was faithful to his promise.

It was in 1787, that Lagrange came to Paris to take his seat in the Academy of Sciences, of which for fifteen years he was *associe etranger*. To give him the right of suffrage in all his deliberations, this title was changed into that of *pensionnaire vétéran*. His new fellows vied in appearing happy and glorious of possessing him: *la reine l' accueillit avec bienveillance; elle le considerait comme allemand; il lui avait été recommandé de Vienne.—Ou lui donna un logement au Louvre; il y vécut heureux jusqu'à la révolution.* The satisfaction which he enjoyed appeared but little outwardly. Always affable when interrogated, he was however under some constraint in speaking, and seemed absent and melancholy; often in a society which must have been according to his taste, in the midst of those savans for whose sake he had come from so great a distance—among the most distinguished men of all countries who assembled whole weeks at the house of the illustrious Lavoisier, I have seen him melancholy, and standing up against a window where nothing could draw his attention. He there remained deaf to all that was said around him; he avowed himself, that his enthusiasm was quenched, and that he had lost all taste for mathematical researches. If he learned that a geometer was engaged on some work, "so much the better," said he, "I began it, and shall be exempted from ending it." But this thinking head could only change the object of its thoughts. Metaphysics, the history of the human mind, that of different religions, the general theory of languages, medicine, botany, shared his leisure. When conversation turned upon subjects that seemed as if they must be most foreign to him, we were struck with a sudden trait, a fine thought, a deep view, that disclosed long reflections. Surrounded by chemists, that had just reformed all the theories, and even the language of their science, he grasped the current of their discoveries, gave to facts previously isolated and inexplicable, that connection which the different branches of mathematics have to each other; he consented to acquire knowledge that had formerly seemed so obscure to him, and that had become as easy as algebra. We were astonished at this comparison; we thought it could come to the mind only of a Lagrange. It appeared to us as simple as just. But it must be taken in its real sense. Algebra, which presents so many insoluble problems; so many difficulties, against which all the efforts of Lagrange himself, had just proved futile, could not appear so easy a study.

But he compared the elements of chemistry to those of algebra. These new elements formed bodies; they were intelligible; they offered more certainty. They resembled those of algebra, which, so far as is invented, offers no difficulty to the conception; no truth to which we cannot arrive by a train of reasoning of the most palpable evidence. The entrance of chemical science seemed to him to offer these same advantages, with a little less certainty and probable stability. Like algebra, it has undoubtedly its difficulties, its paradoxes which can be explained only by much sagacity, reflection, and time; it will have its problems that will remain forever insoluble.

In this philosophical repose he lived until the revolution, without adding any thing to his mathematical discoveries; without even opening a single time his *Mecanique Analytique,* that had been published more than two years.

The revolution offered to savans the opportunity of a great and difficult innovation; the establishment of a metrical system, founded on nature, and perfectly analogous to our scale of numeration. Lagrange was one of the commissioners that the Academy entrusted with this business; he was one of its most ardent promoters; he wished the decimal system in all its purity: he would not forgive Borda the complacency he had shown in ordering fourths of a metre. He was little struck with the objection that was drawn against that system, from the small number of the divisions of its base. He almost regretted that it was not a prime number, such as 11, that necessarily had given a like denominator to all the fractions. We can regard, if we wish, this idea as one of those exaggerations which escape superior minds in the heat of dispute. He employed, however, this number, 11, only to drive away the number 12, which bolder innovators would have substituted for that of 10, that constitutes throughout the base of numeration.

At the suppression of the Academies, they preserved *temporairement,* the commission charged with the establishment of the new system. Three months had scarcely elapsed, when, to *purify* this commission, they struck from its list the names of Lavoisier, Borda, Laplace, Coulomb, Brisson, and that of the astronomer that labored in France. Lagrange was retained. In capacity of president, by a letter which was long and full of goodness, he informed me that I might go and receive the official notice of my *destitution.* As soon as he knew of my arrival, he came to testify to me the regret given him by

the separation of so many brethren. *Je ne sais*, said he, *pourquoi ils m'ont conservé.* But, without being total, it was difficult that the suppresion should extend even to him. The more losses the commission had suffered, the more its concerns was not to be deprived of the regard attached to the name of Lagrange. He was known in other places wholly devoted to the sciences; he had no place in the civil order, or in the administration. The moderation of his character had prevented him from expressing what he could not keep himself from thinking in secret. But never shall I forget the conversation that I had with him at this time. It was the next day after that when an atrocious and absurd decision, shocking to every one who had any idea of justice, had thrown the savans into mourning, by smiting the most illustrious physical philosopher of Europe. *Il ne leur a faller qu' un moment*, said he to me, *pour faire tomber cette tête, et cent anneés peut-être ne suffiront* pas pour en *reproduire une semblable.* We wept together at the fatal consequences of the dangerous experiment that the French had tried. Some time before, we had held a conversation of the same sort in the study of Lavoisier, on account of the process against the unfortunate Bailly. All the futile projects of doing good, seemed to him equivocal proofs of the greatness of the human mind; *Vouler vous le voir veritablement grand; entrer* dans le *cabinet* de *Newton decomposant* la *lumière*, ou *dévoilant le systême du monde.*

Long since did he regret not having listened to those friends, that in the beginning of our troubles, advised him to seek an asylum which he could so easily have found. While the revolution appeared to threaten only the treatment he enjoyed in France, he had neglected that consideration for the curiosity of seeing, close at hand, one of those grand convulsions which it would be always more prudent to witness at a little distance. *Tu l'as vouler*, repeated he to himself, as he confided to me his regrets. In vain had a special decree, proposed by Duséjour in the constituent assembly, assured him of the payment of his pension. In vain did they keep their word. The depreciation of paper money sufficed to render this decree illusory. He had been nominated member of the board of consultation, charged to examine and reward useful inventions. He was made, too, one of the directors of the mint. But this commission offered him few objects capable of fixing his attention, and could not in any sense expel his uneasiness. They wished anew to draw him to Berlin, and offered him his former living. He gave his con-

sent. Hérault de Séchelles, to whom he had applied for a passport, offered to him for greater surety, a mission to Prussia. Lagrange could not agree to leave his country. This repugnance, that he then regarded as a misfortune, was for him a source of fortune and of new glory.

The Normal School, of which he was nominated professor, but which had only a short-lived existence, gave him scarcely time to lay open his ideas on the foundations of arithmetic, of algebra, and of their applications to geometry.

The Polytechnic School, fruit of a more happy idea, had also more lasting success ; and among the best effects that it has produced, we can place that of having given up M. Lagrange to analysis. It was there that he took the opportunity of developing ideas of which the germ was in a memoir that he had published in 1772, and of which the object was to teach the true metaphysics of the integral calculus. To understand it, and to enjoy sooner these happy developments, we saw professors mix with young students. It was there that he composed his *fonctions analytiques*, and his lessons on the calculus, of which he gave many editions. *Ceux qui ont ete a porter de souivre ces intéressantes leçons*, said one of these professors, *(M. Lacroix,) ont en le plaisir de lui voir creér sou les yeux des auditeurs presque toutes les portions de sa theorie, et conservéront precieusement plusieurs variantes que recueillera l' histoire de la science, comme des examples de la marche que suit dans l' analyse le génre de l' invention.*

It was then also that he published his treatise on the solution of numerical equations, with notes and many points of the theory of algebraic equations.

It was said that Archimedes, whose great reputation was particularly founded, at least with historians, on machines of every kind, and chiefly those that had retarded the capture of Syracuse, thought little of those mechanical inventions, on which he wrote nothing. It was said that he placed value only on his works of pure theory. We may sometimes think that our great geometers share, in this respect, the opinion of Archimedes. They regard a problem as solved when it offers no more analytical difficulties ; as solved when nothing remains but to perform differentiations, substitutions and reductions, operations that in fact require scarcely any thing but patience, and a certain habit. Satisfied with having dispersed the more real difficulties, they are too careless about the confusion in which they leave calcu-

lators, and the labor that the use of their formula ought to impose upon them, even after it has been suitably reduced. We would not dare to affirm that Lagrange was more often of this opinion. More than once he openly expressed his wish to see researches purely analytical encouraged ; and even when he seemed to propose to himself the utmost facility of common calculations, he still chiefly perfected analysis.

The general solution of algebraic equations is subject to obstacles thought insurmountable : but, in practice, every determinate problem leads to an equation, of which all the coefficients are given in numbers. It will suffice then to have a sure method of finding all the roots of that equation, which we call numerical. This is the object which Lagrange proposes to himself: he analyzes known methods, demonstrates their uncertainty and insufficiency : he reduces the problem to the determination of a quantity smaller than the smallest difference between the roots. Here is much. We cannot too much admire the analytical science that shines every where in this work ; but, notwithstanding all the resources of the genius of Lagrange, we cannot conceal that the work is still too long, and calculators will doubtless continue to give the preference to means less direct and more expeditious. Four times the author has returned upon this subject. It must be believed that a convenient and general solution will be always refused, or that at least it will be by other means than will be worth while to seek one. The author seems to have so recognized himself, by recommending that of M. Budau as the most easy and elegant for resolving all equations : all the roots are real.

The desire of multiplying useful applications made him undertake a new edition of his *Mecanique Analytique.* His intent was to unfold its more common parts. He therein labored with all the ardor and force of head that he had put to it in his better times. But this application left him a fatigue which sometimes made him fall into a swoon. He was found in this state by Madame Lagrange. His head, as he fell, struck upon the corner of a piece of furniture, and the shock deprived him of the use of his senses. This was a warning to take more care of himself. He thought so too ; but he held too much at heart the final digesting of this work. The edition long in suspense, was not finished till 1815. The first volume appeared some time before his death : it had been followed by a new edition of his *fonctions analytiques.* So many labors exhausted

him. About the end of March fever showed itself, appetite departed, sleep troubled him, his mouth was parched and he underwent alarming swoons, especially when he awoke in the morning. He felt his danger; but keeping his imperturbable serenity, he studied what was going on within him; and, as if he had only to aid in a grand and rare experiment, he gave to it all his attention. His remarks have not been lost. Friendship brought to him, the 8th April, in the morning, MM. Lacépéde and Monge, and M. Chaptal, who considered it a religious duty to collect the principal traits of a conversation that was his last. We have followed scrupulously all the indications it contains, and the passages that we have italicized in another quotation, are faithfully copied from the manuscript of M. le Comte Chaptal.

He received them with tenderness and cordiality. *J'ai eté bien mal avant hier, mes amis,* said he to them, *je me sentais mourir; mon corps s'affaiblissait peu-à-peu, mes facultés morales et physiques s'éteignaient insensiblement; j'observais avec plaisir la progression bien graduée de la diminution de mes forces, et j'arrivais au terme sans douleur, sans regrets, et par une pente bien douce. Oh! la mort n'est pas à redouter, et lorsqu' elle vient sans douleur, c'est une derniere fonction qui n'est ni penible ni désagréable.* Then he explained to them his ideas about life, of which he believed the seat was every where, in all the organs, in the whole mass of the machine, which in his case decayed equally throughout, and by the same degrees. *Quelques instans de plus, il n'y avait plus de fonctions nulle part, la mort était par-tout; la mort n'est que le repos absolu du corps.*

Je voulais mourir, added he with more strength, *oui, je voulais mourir, et j'y trouvais du plaisir; mais ma femme n'a pas vouler: j' eusse préféré en ces momens une femme moins bonne, moins empressée à reanimer mes forces, et qui m'eût laissé finir doucement. J'ai fourni ma carrière; j'ai acquis quelque célébrité dans les mathématiques. Je n'ai hài personne, je n'ai point fait de mal, et il faut bien finir: mais ma femme n'a pas vouler.*

As he was very animated, especially at these last words, his friends, notwithstanding all the interest they took in hearing him, wished to withdraw. He began to give them the history of his life, of his labors, of his success, of his sojourn at Berlin, (where many times he has told us that he had seen close at hand *un roi,*) of his arrival at Paris, of the tranquillity which he had at first enjoyed, of

the uneasiness that had there been given him by the revolution, of the great and unexpected manner in which he had been indemnified for it by a prince greater, more powerful, (and he might have added, still more *able* to appreciate him,) who had decked him with honors and dignities, and who, still recently, had just sent him the grand cordon of the order of the re-union: indemnified, in fine, by one who, after having given him, during his life, unequivocal proofs of the highest esteem, has just done for his widow and his brother, more than ever Frederic had done for himself during all the time that he had adorned his academy.

He had aspired for neither honors nor riches; but he received them with a respectful gratitude, and delighted in them for the benefit of the sciences. He thought fit to deck with these titles the frontispiece of the work, which he caused to be printed, to show to the universe to what degree the savans were honored in France.

We see, by these last words, that he had not lost all hope of cure. He simply believed that his convalescence would be long: he promised them, as soon as his powers returned, to go and dine with M. le Comte de Lacépède, with MM. les Comtes Monge and Chaptal; and there he proposed to give them on his life and his works other details than they could find any where. These details are irrecoverably lost. We are still ignorant of what he had wished, and what he might have been able to add to the second volume of his Mecanique, already in the press. (This volume appeared in 1816.)

During this conversation, which lasted more than two hours, his memory often failed him: he made vain attempts to recall names and dates; but his language was coherent and full of strong thoughts and bold expressions. This employment which he made of his powers, exhausted him. Scarcely had his friends withdrawn, when he fell into a deep faintness; and he died on the 10th April, at nine hours and three quarters of the morning.

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M. Lagrange was of a delicate but fair complexion: his tranquillity, his moderation, an austere and frugal regimen, from which he seldom deviated, prolonged his career until the age of seventy seven years two months and three days. He had twice been married; the first time at Berlin, to do like all the other academicians, of whom none lived in celibacy. He had caused to come from Turin a relative whom he married, and whom he lost after a long sickness, during which he had lavished on her cares, the most tender, ingenious,

and the most sustained. When he afterwards married in France Mademoiselle Lemonnier, daughter of our celebrated astronomer, he said to us, *je n'ai point eu d'enfans de mon premier marriage, je ne sais si j'en aurai* du second, *je n'en desire quères.* What he chiefly desired, was an amiable companion, whose society could offer him some relaxation in the intervals of his labors. In this respect there was nothing more to be desired. Madame la Comtesse Lagrange, daughter, granddaughter, and niece of members of the Academy of Sciences, was worthy of appreciating the name which he was to make her wear. This advantage, restoring in her eyes the inequality of their ages, she soon conceived for him the most tender attachment. He was thankful for it to such a degree, that he could scarcely bear to be separated from her, since it was for her alone, that he felt any regret in leaving life: and since in fine he was heard often to say, that of all his successes, what he valued most was, that they had made him obtain a companion so tender and so devoted. During the ten days that his sickness lasted, she did not lose sight of him a moment, and employed them constantly in reviving his powers, and prolonging his existence.

He loved retirement, but did not require it of the young wife whom he had married: he went out then oftener, and showed himself in the world, where, on other accounts, his dignities obliged him to appear. Very often it could be perceived that he pursued thither his meditations, begun in his study; it was said that he was not insensible to the charms of music. In effect, when a *reunion* was numerous, he was not displeased that a concert should interrupt the conversation, and attract all attention. On one of these occasions, I asked of him what he thought of music? *Je l' aime, parce qu' elle m' isole, j' en ècoute les trois premieres mesures, a la quatrième je ne distingue plus rièn, je me livre à mes reflexiòns, rien ne m' interrompt, et c' est ainsi que j' ai resolus plus d' un problême difficile.* Thus for him, the finest work in music must have been that to which he owed the most happy inspirations.

Though he was blessed with a venerable figure, on which was delineated his fine character, yet never would he consent to sit for his portrait. More than once, by an address of a fair pretext, they had led him in to the sittings of the Institute, in order to paint it without his knowledge. An artist sent by the academy of Turin, drew in this manner the sketch from which he made the bust so often exposed in the hall of our private sessions, and still adorning our library.

His features were moulded after death, and previously while he slumbered, a portrait was made of him that was said to be very correct.

Sweet, and even timid in conversation, he loved particularly to interrogate, either to show the worth of others, or to add their reflections to his vast knowledge. When he spoke, it was always in the strain of a doubt, and his first phrase generally began with *je ne sais pas.* He respected all opinions, and was very far from giving his own as rules. Nor was it easy for him to change them. For he sometimes defended them with a warmth that went on increasing until he perceived some change in himself; then he returned to his usual tranquillity. One day, after a dispute of this sort, Lagrange having gone out, Borda, remaining alone with me, let slip these words; *Je suis fâché d' avoir à le dire d' un homme tel que M. Lagrange, mais je n' en connais pas de plus entêté.* If Borda had gone out first, Lagrange doubtless would have said the same of his brother, a man of sense and much talent. He too, like Lagrange, would not readily change ideas adopted only after a thorough examination.

Often was remarked in his tone a light and sweet irony, the meaning of which it was possible to mistake, and at which I have seen no instance where any one could have felt offended. Thus he said to me one day: "These astronomers are singular; they will not believe a theory, where it does not agree with their observations." The looks of him who made this reflection, on uttering it, marked sufficiently its real meaning. I did not think myself obliged to defend astronomers.

Among so many master-pieces that are due to his genius, his Mecanique is unquestionably the most grand, remarkable and important. The *fonctions analytique* are only secondary, notwithstanding the fruitfulness of the principal idea, and the beauty of the developments. A notation less convenient, calculations more embarrassing, although more luminous, will prevent geometers from employing, unless in certain difficult and doubtful cases, his symbols and his demonstrations; it suffices that he has supported them on the lawfulness of the more expedient methods of the differential and integral calculus. He himself has followed the usual notation in the second edition of his Mecanique.

This great work is wholly founded on the calculus of which he is the inventor. Every thing in it flows from a single formula, and from a principle known before him, but of which the whole use was

far from being suspected. This sublime composition, moreover, unites all those of his preceding works that he could therein embody. It is also distinguished by the philosophical spirit that reigns in it from end to end. It is also the finest history of this part of the science; a history, such as could be written only by a man on a level with his subject, and superior to all his predecessors, whose works he analyzes. It forms a *lecture* of the highest interest, even for him who would be far from being able to appreciate all the calculations of its details. Such a reader will there perceive at least, the intimate connection of all the principles on which the greatest geometers have supported their researches in mechanics. He will there see the geometric law of the celestial motions, deduced from simple mechanical and analytical considerations. From these problems, that serve to calculate the true system of the world, the author passes to questions more difficult, complicated, and belonging to another order of things. These researches are only out of pure curiosity. The author informs us so. But they prove the whole extent of his resources. Therein is seen at last his new theory of the variation of the arbitrary constants, of the motion of the planets, that had appeared with so much éclat in the Mémoires de l' Institut, where it had proved that the author, at the age of seventy five years, had not descended from the high rank which he occupied so long since, with the consent of all geometers.

Throughout his writings, when he quotes an important theorem, he gives credit for it to the first author.

When he corrects the opinions of his predecessors, or of his cotemporaries, he does so with all the respect due to genius; when he demonstrates the errors of those who have attacked him, he does so with the impassability of a true geometer, and the calmness of a demonstrator. None of his celebrated rivals had ideas more delicate, just, general, and deep. In fine, thanks to his happy labors, mathematical science is now like one vast and beautiful palace, whose foundations he renewed, whose pinnacle he crowned, and in which a step cannot be taken without finding monuments of his genius.

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* The author arrived at it by very remarkable artifices of calculation. But the solution is very inconvenient, notwithstanding the elegance of its formula.

Art. VII.—*On the Resistance of Fluids, in reply to Mr. Blake;* by Geo. W. Keely, Prof. of Natural Philosophy, Waterville College.

TO PROFESSOR SILLIMAN.

Sir—When I saw Mr. Blake's first communication in Vol. xxix, No. 2, of this Journal, in which among other novelties, he attacked the Newtonian demonstration of the law of resistance on direct impulse of a fluid, I *did* give it a very careful and attentive perusal, his repeated insinuation to the contrary notwithstanding. I observed that his argument against that demonstration wore two aspects, one *bad* for Mr. Blake, the other *worse*, according as his term "force of resistance" meant the action *in an indefinitely short time*, or *in no time*. The *bad* is bad enough, as your readers must have perceived from my last communication, if not before; but bad as it is, the *worse* is, as will presently appear, so very much worse, that common courtesy forbade that I should, in that communication, even state the alternative. Mr. Blake, however, has eagerly vindicated his right to the *worse*, and thereby has, with some probably, gained a temporary advantage: of how much real value this is, shall soon be shewn.

Understanding now that Mr. Blake, by "force of resistance," or "force," means action in no time, I propose to prove,

First, That Mr. B. has misunderstood the meaning of the demonstration he has attacked.

To do this, I will first quote the demonstration as given by Professor Olmsted, in his Natural Philosophy.

"Both the number of particles which meet the plane, and the *force* of each, are as their velocity: hence the resistance is proportional to the square of the velocity." This is also the argument of *Newton* and all his followers.

Now, your readers will remember that in Mr. Blake's first communication, he undertakes to demonstrate that his "force of resistance," or "force," is as the square of the velocity. Then follow the two annexed sentences.

"Since the area of the plane is given, the number of particles in action at any moment is given, and consequently the force of each, at any instant, is as the square of the velocity of the plane."

"We may now note a fundamental error in the received theory, which assumes, usually without argument, that the force of each

particle is as the velocity of the plane, instead of the square of the velocity, as we have now shown it to be."

Now who does not see that in these sentences, Mr. Blake identifies his "force" of a particle, with the force of a particle as the term is understood in the common theory, and if we take as the meaning of his "force," what he insists upon, viz. *the action at a point of time*, i. e. in no time, is it not obvious that he has committed an error? Does not Mr. B. know that the force of a particle in the common theory, is the vis motrix, *the momentum*, in short, *the whole force of a particle*, and has he not expressly said, in his last paper, "when I determined the force of a particle, I determined not *its whole action*, but only its action *at* any instant?" Any comment is unnecessary. There is not even the consolation of a dilemma. I do not pretend to *know* whether this will "*amuse*" your readers, but coming as it does from a professed reformer of the abuse of compounding terms, it is sufficiently amusing.

But secondly, is it not most clear that Mr. Blake has entirely failed in his attack upon the demonstration of the received theory? The only argument he pretends to bring against it is this. It is "a fundamental error," in that demonstration that the force of a particle is as the volocity, because I prove that the force of a particle is as the square of the velocity; which, in the light of his definition is just this: it is a fundamental error in that demonstration that the *whole* force of a particle is as the velocity, because I prove that that force of a particle which is *not* the whole action, but the action in no time, is as the square of the velocity.

The above is, in substance, the argument I should have given in my last, could I have thought that Mr. Blake could have overlooked a point so essential to even an appearance of success. Here, therefore, I might close, for my whole object has been to defend the arguments and conclusions of the common theory, and your readers must have perceived it. That theory was attacked by Professor Wallace; I showed that his objection to it rested on an unwarrantable assumption: it was again attacked by Mr. Blake. I have now shown that his objection to it rests on an error. With your permission, however, Mr. Editor, I will make a few additional remarks. And first, if any of your readers suppose that, having regard to Mr. Blake's formal definitions of "force of resistance," or "force," viz. "*irrespective of duration*," "*at any indivisible instant*." I ought to have understood, in spite of the evidently consequent error, that he

meant the action *in no time;* let them consider that "*irrespective of duration,*" sometimes means that time is constant, and that* *at any indivisible instant,* is not void of that ambiguity to those who know the different meanings attached to the differential element (dt); and further, that what words mean is fixed as much by their use as by formal definitions, and that if I had taken the meaning, *in no time,* there followed, not only the gross error above pointed out, but Mr. Blake's demonstration of the "force of resistance," was absolutely without meaning as such.

As my object has been to defend the common theory, any remarks on Mr. Blake's proof, that the "force of resistance" is as the square of the velocity, must now be considered gratuitous: whether just or not, they have now nothing to do with the point at issue between us, viz. the truth of the demonstration above given of the law of resistance on direct impulse. With my former understanding of Mr. B's "force of resistance," it was a material point whether his proof, that it was as the square of the velocity was correct, since he identified it with the force in the common theory: hence I attacked it.† Mr. Blake thinks that by insisting on his definition, he has saved his argument: if he had regarded the true meaning of my objection to that argument, instead of the mere form of it, he would have seen that it remains in full force. That objection is that the definition and the argument are heterogeneous. This is true, considering as I did in my last communication, that the action of Mr. B.'s force of resistance, took place in an indefinitely small invariable element of time; it is true if, as we are now to understand, it takes place in no time at all; and Mr. B. may vary his definition as he pleases, the objection I urged against that argument will always be fatal to it, if used to demonstrate any other than the value of a force which acts *in variable time.* The two first of the "analogies," as Mr. Blake terms them, in his argument, which express substantially the 2d and 3d of Newton's Laws of Motion, are not abstract conceptions which will apply to determine the value of any thing, whether real or im-

* It was through an error of the pen that I appear to have misquoted Mr. Blake, putting the quotation marks before the word *in,* instead of after it, as I have done in all other cases, and they are numerous.

† I again suggest that, though the common theory takes the force of a particle to be as the velocity, it may, its action occupying time, be taken to be as the square of the velocity; and if these measures are rightly understood, the results will be the same.

aginary, that is called force. Among the infinite number of laws mathematically possible, these are the only ones that are physically true. They can be proved by experiment, and are obtained by induction from observed facts, and unless they are applied to cases of the same nature, they prove nothing. I know that some writers have neglected to observe these principles. Professor Farrar, for example, in his Mechanics, has, under the head of statics, given a demonstration, not of the parallelogram of forces, which is no where in his work proved, but of the parallelogram of motions, or velocities.* But Mr. Blake has left far behind him all precedents. He applies these laws of motion to the determination of an instantaneous impulsive force, a thing which has no existence in nature, and of which I can form no conception. How can the laws of motion, got by induction of facts, be applied to determine such a force, or such a force be applied as Mr. Blake applies it, to determine an actually existing force? I say then, as before, that the logic of that reasoning is unsound, and that Mr. Blake "setting out to determine the 'force of resistance' has unconsciously determined a quantity of a very different nature."

I have no time, nor inclination, nor need for remark on Mr. Blake's curious suggestions respecting the Leibnitzian controversy, and the possibility of my confounding the vis motrix and vis mechanica.

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* I know how difficult it is to give a simple elementary demonstration of that important proposition, but it were better to give a proof, though unintelligible to beginners, than to leave that whole grand division of Mechanics without foundation. Unfortunately the foundations of both Statics and Dynamics, in the work referred to, are assumed.

Art. VIII.—*On the Gales and Hurricanes of the Western Atlantic;** by W. C. Redfield, Esq. of New York.

From the U. S. Naval Magazine.

As an accurate knowledge of the dangers to which the navigator is liable, is of the first importance to the nautical profession, I venture to point out an error, relating to the storms of the Atlantic, which has found its way into Purdy's Memoir of the Atlantic Ocean, and has also been copied from that useful manual, into the nautical books of other countries.

The error alluded to, is found in the following paragraph:—"In the year 1782, at the time the Ville de Paris, Centaur, Ramilies, and several other ships of war, either foundered, or were rendered unserviceable, on or near the banks, together with a whole fleet of West Indiamen, excepting five or six, they were all lying-to, with a hurricane from west; the wind shifted in an instant to east, and blew equally heavy, and every ship lying-to, under a square course, foundered."—*Memoir of the Atlantic, 7th edition, page* 96.

In the examination which I have been led to make of the storms of the Western Atlantic, I have found them to pursue a generally uniform course, which is always north-westerly, in the tropical latitudes, and till they approach the latitude of 30° N. In the vicinity of this parallel, the storms turn to the northward, and their course then becomes north-easterly, on a track which appears to incline gradually to the east, as they sweep over the higher latitudes of the Atlantic. The course thus pursued, is entirely independent of the direction of wind which the storm may exhibit at the different points over which it passes; the wind in all such storms being found to blow after the manner of a whirlwind, around a common center or vortex, during their entire progress, in a circuit which is commensurate with the lateral extent of the storm; and in a determinate direction or course of rotation, which is from right to left, (that is, in the direction from west to south,) horizontally.

From this uniform course and regular rotative action, result certain regular phases or characteristic changes, which are peculiar to

* These remarks, and the chart which they are designed to illustrate, were originally prepared for the London Nautical Magazine, but the importance of the subject in its relation to our marine interests, as well as the cause of science, has induced the author to revise the same for publication on this side of the Atlantic.

the opposite margins or longitudinal sections of the track of each and all of these storms.*

At an early period of the inquiry, I met with the statement above quoted from the Atlantic Memoir, which, by the direction and change of wind therein mentioned, seemed to indicate that this region of the Atlantic had been visited at least by one storm of a different character. Such, however, was the remarkable uniformity presented to my view in the phenomena of the storms which were investigated, that I was led, at length, to suspect some error in the above statement, and on further inquiry, I soon found my doubts fully justified. I have now before me several printed authorities of that period, from which it appears that the first part of the hurricane in question, was from *E. S. E.* and that it shifted suddenly to *N. N. W.*†

It appears, therefore, that instead of blowing as described in the Memoir, this gale exhibited the usual characteristics of the Atlantic hurricanes.

If the movements of the atmosphere in these storms were of the vague and erratic character which has usually been assigned to them, the above correction would be of little importance. But, notwithstanding the supposed, and even proverbial uncertainty of the winds, navigators may be assured, that they will never, in the temperate

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* See American Coast Pilot, 12th edition, page 626—629; or the American Journal of Science and Arts, vol. xxv. pp. 114—121.

† *Extract from the Journal of an Officer on board the Ramilies.*

"September 16th, 1782. At noon, lat. 42° 15′, lon. 48° 55′, wind at E. S. E., blowing fresh; 1 P. M. gale increased, hazy weather; at 3 took in sails; at 6 P. M. gale very strong; brought-to under the mainsail. Midnight, three and a half feet water in the hold; gale E. S. E. exceeding strong; at 2 A. M. on the 17th, heavy rain and squally; at 3 A. M. the wind shifted; a violent squall from the N. N. W. without the smallest warning of a shift, took the mainsail aback; the mainmast, mizenmast, fore-topmast, and fore-yard, carried over the ship's side, and the tiller broke; water 4 feet 4 inches, and gaining on us; at daylight, 5 feet 8 inches, and gaining, ship laboring in great distress; at 5 A. M. one of the convoy foundered close to us; several near us dismasted, and signals of distress making from all; a prodigious swell of the sea, and heavy gale from N. W.; at 10 A. M. hard gale from N. W. and prodigious swell; six feet water in the hold; afternoon, threw guns overboard," &c.

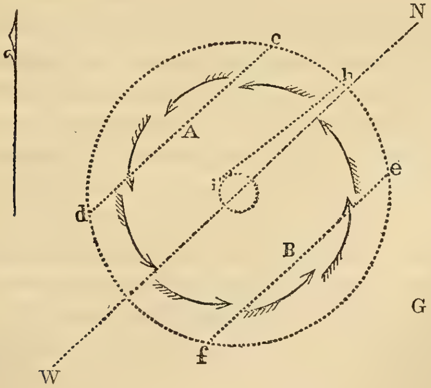
A letter from Captain Edwards, who commanded one of the convoy which foundered after the storm, states the early part of the gale to have been from S. E. by E. and the shift to have been to N. W. This trifling discrepancy confirms, rather than invalidates, the general fact, and may be accounted for as a slight inaccuracy on the part of the observers, or by supposing the position of Capt. Edwards's ship to have been some distance to the southward and eastward of the Ramilies.

latitudes of the Atlantic, encounter a gale which shall blow violently from the west, and then shift suddenly to the east. This cannot happen until storms in this region shall be found pursuing a retrograde course, or else spinning from left to right, instead of from right to left as they have heretofore done; or, in other words, till a new system of terrestrial physics shall have been established by the Great Author of nature.

The interest of this subject to navigators, and the neglect into which this branch of philosophic inquiry has been suffered to fall, will be a sufficient apology for some additional remarks on these storms.

Those who adopt the views which I have maintained on this subject, will doubtless be able to explain, in a satisfactory manner, the facts which are contained in the following statement, found in the paragraph next preceding that which we have quoted from the Memoir; namely, "That while one vessel has been lying-to in a heavy gale of wind, another, not more than thirty leagues distant, has at the very same time been in another gale equally heavy, and lying-to with the wind in quite an opposite direction."

This statement is obviously to be understood as applicable to two vessels falling under the two opposite sides or portions of the same storm, where the wind in its regular circuit of rotation, must, of course, blow from the opposite quarters of the horizon. We will suppose one of the vessels to be at A and the other at B, in the annexed figure.



The storm in pursuing its course from W towards N, will strike the first mentioned vessel in the direction which is shown by the

wind-arrows at the point *c*, which, if the position be in the temperate latitudes, north of 30°, will be from eastward. Now, it is obvious, that as the storm advances in its course north-eastward, this vessel, if nearly stationary, will intersect the body of the gale on the line *c* A *d*. As the storm advances, the wind must also veer to the northward, as shown by the arrows, being at N. E. when the vessel is brought under the point A, and near the close or departure of the storm by its further progress eastward, the wind will have further veered to the direction shown at *d*, which, with due allowance for the progressive motion of the storm, we will set down at N. N. W. The other vessel, as is equally obvious, will first take the wind from the southward, as shown at *e*, in which quarter it will blow, with no great variation, till, by the advance of the storm, the ship is brought under the point B. The barometer, which had previously been falling, will now commence rising, and the wind, veering more westerly, will, at the departure of the storm, be found in the direction shown at *f*, which, after the allowance already referred to, may be stated at W. N. W. Such, substantially, are the facts commonly reported by vessels which fall under the lateral portions of the Atlantic storms, and it is readily seen, that the opposite winds, which are exhibited on the two different intersections of the storm, as above described, will very naturally be mistaken for two separate and distinct gales.

The phases of the wind in these gales are, however, in all cases, modified more or less by the course or changing position of the vessel exposed to its action. For example, a ship on taking the gale, say at E. S. E. at the point *h*, on the figure, and lying-to with her head to the northward, may by that means be brought to intersect the storm on the line *h i*, and at the point *i*, would suddenly be taken aback, with the wind say at N. N. W., as in the case of the homeward-bound fleet in 1782, and the barometer, which reaches its lowest depression under the central portion of the storm, would about this period be found to have commenced rising with some degree of rapidity.

A further reference to the figure will show that a ship, which may be at the point G during the passage of the gale, would be exposed to a heavy swell from the southward and westward; but being beyond the organized limits of the storm,* may remain entirely unaf-

* The terms *organized* and *organization*, are used by the writer in the sense in which he conceives them to be applicable to all eddies, whirlpools, and whirlwinds, and generally, to all fluid and aërial vortices, while in a state of activity,

fected by the violence of the wind, which at the same time may be raging with destructive fury at the distance of a few leagues. The writer has knowledge of many such examples.

It has been suggested that "the larboard tack is the proper one to lie-to on, as the wind will then be found to draw aft;" but this will frequently prove erroneous, as the wind may draw either way, on either tack, according to the position and course of the ship, in the storm, and the extent and rate of progress of the latter. In the case of the fleet which encountered the gale of 1782, it was probably the best course to carry sail to the northward at the very commencement of the gale, and as far and as long as possible. By this means, the fleet might perhaps, have been drawn as far northward as the point A on the figure, and the change of wind to the northward and westward would then have been rendered more gradual. The chief difficulty and danger is when the direction of the wind at the first setting in of the gale, is found to be nearly at right angles with the known courses of the storms in the region where the gale is encountered, and it is then desirable to pursue such a course as to avoid, if possible, falling into the heart of the storm.

The following passage is found in a late edition of the Atlantic Memoir, at the head of the article on Hurricanes.

"A hurricane is a tempest of the most extraordinary violence, forming a kind of imperfect vortex, towards the center of which the wind proceeds, successively and abruptly, from different points of the horizon. Of such phenomena, the most violent and destructive in the western hemisphere, are known to originate in or near the West Indies; and they commonly proceed in a cycloidal line, from their point of origin, to the W. N. W., N. W. and N.; or if limited to the West Indian sea, from E. S. E. to W. N. W. *as well as from W. N. W. to E. S. E."—Memoir, page 97, 7th edition.*

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and as involving, in the case of storms, the production of rain, and all the other incidental phenomena which result from such organized action. The true character of these rotative movements, does not appear to have been closely studied by men of science, and however necessary or desirable a more correct knowledge of these movements may be, in order to a just apprehension of the subject before us, still a discussion of their specific character, and of their agency in the production of the most important atmospheric phenomena, even if the ability were possessed, would be foreign to our present object. It is believed, however, that a proper development of this subject would do much to illustrate, in a clear and satisfactory manner, the formation and production of storm-clouds and rain, and especially of summer hail, as well as all violent electric phenomena.

As most of this paragraph was probably intended to agree with the facts which I had formerly given in relation to these hurricanes, it will only be necessary to notice the closing statement, quoted in italics, in connection with another passage which introduces the abstract, that is given in the Memoir, of my earliest attempt to elucidate the character and course of these tempests, and particularly those of 1821 and 1830.

"With these hurricanes, (says the Memoir,) might have been included the ever-memorable one of the year 1780; the latter it appears commenced near the west end of Cuba. On the 3d of October, it passed over the western part of Jamaica, and reduced Savanna la Mar to a state of desolation; it then in its gyrations passed along the coasts of Hayti, or St. Domingo, and Porto Rico, and it ended at Barbadoes, on the 10th of the same month."—*Memoir of the Atlantic, 7th edition, page* 101.

It must be evident that if there be no error in the statements here quoted, the systematic and uniform movements which I have considered as pertaining at least to all hurricanes which visit the western portions of the Atlantic, are liable to some decided exceptions, and it is important therefore, that the facts of the case should be ascertained. I am confident, however, that on a full and careful inquiry, we shall find that nature has not, in this case, been regardless of her own fixed laws, and accustomed modes of action.

From such evidence as I have in my possession, it appears, that the first hurricane of October, 1780, passed over the western part of Jamaica on the 3d of that month, and that the storm commenced a few hours *earlier* at Black River and Montego Bay, than at Savanna la Mar, which is near the west end of the island;* and also, that on the 4th, at half past 5 A. M. the British frigate Phœnix, was wrecked on the island of Cuba, near Cape Cruz, a little before the close of the gale at that point, *but several hours after its termination at Jamaica.* There are no accounts from which I can infer either the presence or absence of the storm on the more usual course down the Caribbean sea, into the gulf of Mexico, but if following the indications already before us, we suppose the storm to have commenced

* The northwestward or more northward course of this hurricane is fully settled, by the fact that the Phœnix first took the gale on the evening of October 2d, off port Antonio, which is on the eastern part of the island of Jamaica; as appears from the very interesting account of Lieut. Archer, which was not at hand when the above was written.

its *detour* to the northward, and which accords well with the general course of a storm of a corresponding date, in the year 1830, on a more eastern meridian, we shall then recognize it as the hurricane which was encountered on the 5th of October, in the gulf of Florida, and northward of the Bahama Islands, in which many vessels were wrecked, and a squadron of H. M. ships was entirely disabled. This storm appears also to have been of limited extent and duration, as compared with that which visited Barbadoes on the 10th, and I can find no evidence of its having pursued a retrograde or eastwardly course while in the tropical latitudes.

The violent and extensive hurricane which desolated Barbadoes on the 10th of the same month, appears to have commenced at St. Lucia several hours *later* than at Barbadoes, and I also find that it did not take effect at the other neighboring islands till the 11th, which is sufficient proof that this storm could not have been the same which ravaged the western parishes of Jamaica, on the 3d of the month. In its lateral extent it covered at one and the same time, the entire distance between the islands of Antigua and Tobago, and it appears to have pursued the usual course or route, towards the north-west. A letter from Jamaica mentions that they had a small share of this hurricane at that island on the 12th, which is in due course of time, and accords with the extent and previous position of the gale. It appears, in its wide spread desolations, to have dispersed a Spanish fleet off Havana on the 16th, and to have visited with its opposite margin, the island of Bermuda, on the 18th of the same month. I have also two accounts from vessels which encountered this storm at sea on the 17th, which agree with the foregoing.

The errors in the statements last quoted from the Memoir, seem to have arisen from mistaking two hurricanes of different dates, which passed in a north-westerly course, for one and the same storm passing eastward; or possibly, from conceiving the direction of the wind from a western quarter, at some of the islands, during the first part of the storm of October 10th and 11th, as directly indicating the route of the gale; a very natural conclusion, and one that is perhaps, identified with all our preconceived associations on this subject. It is by this instinctive association that most writers appear to be governed, in their accounts of violent storms, but than which, in its application to the point before us, nothing can be more fallacious and unfounded, as the history in detail of all such storms will certainly show. So strong indeed is the influence of our established modes of thinking

on this subject, that it seems to be difficult, even for those who admit the rotative character of these hurricanes, to understand correctly the true bearing and relations of the different phases of the wind, which are presented at two or more points or places, visited by the same storm, unless the subject has been thoroughly and carefully studied. Speculative opinions also upon the course of a storm, are usually, if not always, founded upon the erroneous notion of a rectilinear course in the wind. In the accounts received of a hurricane at Barbadoes on the 3d of September, 1835, which raged for a few hours from E. N. E. fears were expressed for the safety of the islands to the northward; but subsequent intelligence from Guadaloupe and Martinico, shewed that the gale had not extended to these islands. Had the direction and phases of the wind been viewed in their true relations, it would have been perceived that the heart of the gale must have passed to the southward of Barbadoes; and as a general rule in the West India latitudes, where the onset of the storm is found to be in the general direction of the trade wind, or more eastward, the observer may consider himself as under the northern verge of the gale; but if the onset of the gale be from the north-westward, veering afterwards by the west to the southern quarter, the heart of the storm will be found to have passed to the northward of the point of observation, the latter being under the southern margin of the gale.

Among other proofs of the circuitous action of violent winds, is the fact that the track of a vessel which runs directly before the gale, will in many cases, be found to be strikingly curvilinear when traced on the chart; in other words, the veering of the wind which so often occurs, when duly considered, is in itself, a complete demonstration of the fact in question. Many readers will recollect the case of a vessel driven from Falmouth in the great hurricane of 1703, by a circuitous course to the Isle of Wight, with only a cabin boy on board, which course clearly indicates the phases of one marginal section of that memorable storm. It can but seldom happen, however, that the track of a vessel which scuds through a gale, will fully develop the entire circuit of the wind, the combination of circumstances necessary to this result being but rarely encountered. Still I have obtained notice of a few such cases, and a respectable ship-master not long since informed me that he once scudded for twenty-four hours, under a typhoon in the China sea, and on its departure, found himself nearly in the position where he first took the gale.

In order to illustrate more fully the foregoing remarks, I annex a chart of the Western Atlantic, on which is delineated the route of several hurricanes and storms, as derived from numerous accounts which are in my possession, by which their progress is specifically identified from day to day, during that part of their route which appears on the chart.

The route designated as No. I, is that of the hurricane which visited the islands of Trinidad, Tobago, and Grenada, on the 23d of June, 1831. Pursuing its course through the Caribbean sea, it was subsequently encountered by H. M. Schooner Minx, and other vessels, and its swell was thrown with great force upon the south-eastern shores of Jamaica on the 25th, while passing that island, where the wind at this time was light from the northward. After sweeping through the Caribbean sea, this hurricane entered upon the coast of Yucatan, on the night of June 27th, having moved over the entire route from Trinidad to the western shore of the bay of Honduras, in a little more than one hundred hours, a distance of about seventeen hundred nautical miles, which is equal to seventeen miles an hour. I have no account of this storm after it crossed the peninsula of Yucatan, and it is probable that it did not again act with violence upon the ocean level. Its course or track to Honduras was N. 74° west.

Track No. II, is that of the memorable hurricane which desolated Barbadoes on the night of August 10th, 1831, and which passed Porto-Rico on the 12th, Aux-Cayes and St. Jago de Cuba on the 13th, Matanzas on the 14th, was encountered off the Tortugas on the 15th; in the gulf of Mexico on the 16th, and was at Mobile, Pensacola, and New Orleans on the 17th; a distance of 2,000 nautical miles in about 150 hours, equal to something more than 13½ miles an hour.* Its course, until it crossed the tropic of Cancer was N. 64° west, or W. N. W. nearly. In pursuing its northern course, after leaving the ocean level, it must have encountered the mountain region of the Alleganies, and was perhaps disorganized by the resistance opposed by these elevations. It appears, however, to have caused heavy rains in a large extent of country lying north-eastward of the gulf of Mexico.

Track No. III, is that of the destructive hurricane which swept over the Windward Islands, on the 17th of August, 1827; visited

* Mr. Purdy states that this gale was felt at Natchez, 300 miles up the Mississippi.

St. Martin's and St. Thomas on the 18th; passed the north-east coast of Hayti on the 19th; Turks Island on the 20th; the Bahamas on the 21st and 22d; was encountered off the coast of Florida and South Carolina on the 23d and 24th; off Cape Hatteras on the 25th; off the Delaware on the 26th; off Nantucket on the 27th; and off Sable Island, and the Porpoise Bank, on the 28th. Its ascertained course and progress is nearly 3,000 miles,* in about eleven days; or at the average rate of about eleven miles an hour. The direction of its route before crossing the tropic, may be set down at N. 61° west, and in lat. 40° while moving eastward, at N. 58° E.

Track No. IV, represents the route of the hurricane which ravaged the islands of Antigua, Nevis, and St. Kitt's on the afternoon and night of August 12, 1835; St. Thomas, St. Croix, and Porto Rico on the 13th; Hayti and Turks Island on the 14th; the vicinity of Matanzas and Havana on the 15th; was encountered off the Tortugas in the gulf of Mexico on the 16th; in lat. 27° 21′, lon. 94°, and other points on the 17th and 18th; and also at Metamora, on the coast of Mexico, (lat. 26° 04′) on the 18th, where it was most violent during the succeeding night.† This storm is remarkable, as moving more directly, and farther to the west, than is usual for storms which pass near the West India Islands, it having reached the shores of Mexico before commencing its sweep to the northward. Its course so far as known, is N. 73° west:—its progress more than 2,200 miles in six days; which is nearly equal to 15½ miles per hour.

Track No. V, is that of the extensive hurricane of September, 1804. It swept over the Windward Islands on the 3d of that month; the Virgin Islands and Porto-Rico on the 4th; Turks' Island on the 5th; the Bahamas and gulf of Florida on the 6th; the coast of Georgia and the Carolinas on the 7th; the great bays of Chesapeake and Delaware, and the contiguous portions of Virginia, Maryland,

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* All the distances are expressed in nautical miles.

† Since writing the above it is ascertained that this storm also passed over Galveston bay, on the coast of Texas, where the hurricane blew with violence from the northeast, while at the mouth of the Mississippi and along the northern shores of the gulf, the gale was not felt. Such facts appear quite sufficient to overthrow the hypothesis of Franklin relating to northeast storms, and are equally fatal to the more common theories. At Galveston this storm, in passing over, veered by east to the southeast; the *rationale* of which may be made evident by drawing a line through the northern side of the figure on the chart, parallel to the track of the storm. A little further attention to the figure will also illustrate the general character of other *northers*, which are so common on the coast of Mexico during a considerable portion of the year.

and New Jersey, on the 8th; and the states of Massachusetts, New Hampshire and Maine on the 9th; being on the highlands of New Hampshire, a violent snow storm. The destructive action of this storm was widely extended on both sides of the track indicated upon the chart, and the same fact pertains, in a greater or less degree, to the other storms herein mentioned. It appears to have passed from Martinico, and the other Windward Islands, to Boston in Massachusetts by the usual curvilinear route, in about six days; a distance of more than 2,200 miles, at an average progress of about 15½ miles per hour.

Track No. VI, is that of the memorable gale of August, 1830, which, passing close by the Windward Islands, visited St. Thomas' on the 12th; was near Turks' Island on the 13th; at the Bahamas on the 14th; on the gulf and coast of Florida on the 15th; along the coast of Georgia and the Carolinas on the 16th; off Virginia, Maryland, New Jersey, and New York on the 17th; off George's Bank and Cape Sable on the 18th; and over the Porpoise and Newfoundland Banks on the 19th of the same month; having occupied about seven days in its ascertained course from near the Windward Islands, a distance of more than three thousand miles; the rate of its progress being equal to eighteen miles an hour.* If we suppose the actual velocity of the wind, in its rotary movement, to be five times greater than this rate of progress, which is not beyond the known velocity of such winds, it will be found equal, in this period, to a rectilinear course of fifteen thousand miles. The same remark applies, in substance, to all the storms which are passing under our review. What stronger evidence of the rotative action can be required, than is afforded by this single consideration?

Route No. VII, is that of an extensive gale, or hurricane, which swept over the Western Atlantic in 1830, and which was encountered to the northward of the West India Islands on the 29th of September. It passed on a more eastern route than any which we have occasion to describe, to the vicinity of the grand Bank of Newfoundland, where it was found on the 2d of October, having caused great damage and destruction on its widely extended track, to the many vessels which fell on its way. Its course is quite analogous to that which we have considered as having been probably pursued by the

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* For a more extended notice of this storm, see American Journal of Science, Vol. xx. pp. 34—38.

hurricane of October 3d, 1780. The ascertained route may be estimated at eighteen hundred miles, and the average progress of the storm at twenty five miles an hour.

Route No. VIII, is that of a much smaller, but extremely violent hurricane, which was encountered off Turks' Island on the 1st of Sept., 1821; to the northward of the Bahamas and near the lat. of 30° on the 2d; on the coast of the Carolinas early in the morning of the 3d; and from thence, in the course of that day, along the sea-coast to New York and Long Island; and which, on the night following, continued its course across the states of Connecticut, Massachusetts, New-Hampshire, and Maine. I am not in possession of accounts by which its farther progress can be successfully traced.* The diameter of this storm appears to have greatly exceeded one hundred miles; its ascertained route, and progress is about eighteen hundred miles, in sixty hours; equal to thirty miles an hour.

The last mentioned route may also be considered to be nearly the same as that of a similar, but less violent storm, which swept along the same portion of the coast of the United States on the 28th of April, 1835.

No. IX, represents the route of a violent and extensive hurricane, which was encountered to the northward of Turks' Island on the 22d of August, 1830; northward of the Bahamas on the 23d; and off the coast of the United States on the 24th, 25th, and 26th of the same month.

Much damage was done on the ocean by this storm; but it scarcely reached the American shores. Its duration off this coast, was about forty hours, and its progress appears to have been more tardy than that of some other storms.

No. X, represents the track of a violent hurricane and snow-storm, which swept along the American coast from the lat. of 30° N. on the 5th and 6th of December, 1830.

The last mentioned track also corresponds to that of another storm, of like character, which swept along the sea-coast on the 13th, 14th, and 15th of January, 1831. These violent winter storms exhibit nearly the same phases of wind and general characteristics, as those which appear in the summer and autumn.

Track No. XI, represents a portion of the general route of the violent inland storm which swept over the lakes Erie and Ontario

* The phenomena and progress of this storm have been more fully noticed in Silliman's Journal, Vol. xx. pp. 24—27.

on the 11th of November, 1835. This storm was very extensive, spreading from the sea-coast of Virginia into the Canadas, to a limit, at present, unknown. The anterior portion of this gale was but moderately felt, and its access was noted chiefly, by the direction of the wind, and the great fall of the barometer; the violence of the storm being chiefly exhibited by the posterior and colder portion of the gale, as is common with extensive overland storms. The regular progression of this storm in an easterly direction is clearly established, by facts, collected by the writer, from the borders of Lake Michigan, to the Gulf of St. Lawrence and the sea-coasts of New England and Nova Scotia.

I have thus given a summary description of the route of twelve storms, or hurricanes, which have visited the American coasts and seas, at various periods, and at different seasons of the year. The lines on the chart, which represent the routes, are but approximations to the center of the track or course of the several storms; and the gales are to be considered as extending their rotative circuit from fifty to three hundred miles, or more, on each side of the delineations; the superficial extent of the storm being estimated both by actual information and by its duration at any point near the central portion of its route, as compared with its average rate of progress. The figure which appears upon the chart, on tracks No. I, IV, and VII, will serve in some degree to illustrate the course of the wind in the various portions of the superficies covered by the storm, and also, to explain the changes in the direction of the wind which occur successively at various points, during the regular progress of the gale. The dimensions of the several storms, appear also to have gradually expanded during their course.

Storms of this character do not often act with great violence on any considerable extent of interior country to which they may arrive. Even upon the coasts on which they enter, such violence is not often experienced under the posterior limb of the gale which sweeps back from its circuit over the land, the usual woodlands and elevations being a sufficient protection. Often, indeed, the interior elevations afford such shelter as entirely to neutralize the effect of the wind at and near the surface, and the presence and passage of the hurricane is, in such cases, to be noted chiefly by the unusual depression, which the great whirling movement of the incumbent stratum of air produces in the mercury of the barometer, which thus indicates the presence or passage of the hurricane, in positions where the force of the wind is not felt at all, or only with a moderate degree of violence.

The action of these storms appears, indeed to be at first confined to the stratum or current of air moving next the earth's surface, and they seldom, while in this position, appear to exceed a mile or so in altitude; and the course of the next highest or overlying stratum does not in these cases seem to be at all affected by the action of the storm below. During their progress, however, by the influence of high land and other causes, the storms often become transferred, in whole or in part, to the next higher stratum of current. Thus we sometimes see a stratum of clouds moving with the full velocity of a violent storm, while the stratum of surface wind is nearly at rest, or moves with its ordinary velocity; and thus also it happens that balloons, ascending under such circumstances, are carried forward with a velocity of from sixty to one hundred miles an hour. The foregoing remarks are by no means hypothetical, but are the result of long continued observation and inquiry.

It will hardly escape notice that the track of most of these hurricanes, as presented on the chart, appears to form part of an elliptical or parabolic circuit, and this will be more obvious if we make correction, in each case, for the slight distortion of the apparent course in the higher latitudes, which is produced by the plane projection. We are also struck with the fact that the vertex of the curve is uniformly found in or near the 30th degree of latitude. In connection with this fact it may also be noted, that the latitude of 30° marks the external limit of the trade winds, on both sides of the equator; and perhaps it may not prove irrelevant to notice, even further, that by the parallel of 30° the surface area, as well as the atmosphere, of each hemisphere is equally divided; the area between this latitude and the equator being about equal to that of the entire surface between the same latitude and the pole. It is not intended, however to make these facts the basis of any theoretical inductions on the present occasion.

It will doubtless appear desirable to know whether, if the full history of these or other storms could be obtained, the track in any case, would result in the completion of an entire circuit, either in the proper basin of the North Atlantic, or in its continental borders; and if so, whether there be, or be not, any general uniformity in the length of the major axis of this elliptical circuit at different seasons of the year? If this inquiry cannot be satisfactorily solved, it is still important to learn the analogies or relations which the storm-tracks on the eastern borders of an oceanic basis, bear to those in its western portions, or in other regions. On the Asiatic coasts of the northern

Pacific, unless I have greatly mistaken the evidence, the same system of storms is found to prevail as in the Western Atlantic in the cases before us. On the western coast of North America it will appear, from the phases of storms as described by Cook and other voyagers, that their usual course is in a southeasterly direction. The evidence, in the case last mentioned, though it may be satisfactory to those who are familiar with the modes of investigation, can hardly be estimated by general readers, and will not, therefore, be here insisted on. The journals of voyagers and other published records, when sufficiently examined and collated, are deemed to afford decisive evidence that a system of the same general character, prevails in the southern hemisphere, but exhibiting for the most part, precisely counter movements. If there be any important exception, it will probably be found in the limits of those *counter movements of the regular trade winds* on both sides of the equator, which are known as the westerly monsoons;* but even in these regions, it is questionable whether the course of violent storms be not uniformly the same as in other regions of corresponding latitude; but more facts of a decisive character are wanted before this point can be settled to the satisfaction of the writer.

The routes of many other storms and hurricanes might be traced on the chart, from materials now in hand, were it necessary; and they may it is believed, be somewhere found in action at all seasons, and on every day in the year, although their appearance is more frequent in some seasons and even in some years than in others. The hasty outline of their progress and development, now submitted, is probably, quite sufficient to overthrow some of the most common hypotheses respecting their origin and times of appearance.

Perhaps it might be deemed proper to point out on the present occasion, the catenation of natural causes by which the systematic organization and progress of these storms is produced and maintained;

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* The author is willing to be held responsible for this implied definition of the general character of the monsoons, as he finds good reason to consider these winds to be neither more nor less than a misplaced or counter deflection in the course of the regular trade winds, occasioned probably, by the contour and position of opposing coasts and elevations, and especially by the inferior current of atmosphere which is necessarily produced by certain extensive elevations of the earth's surface. It is to fallacious or misapplied reasonings, founded on a certain known principle of expansion and every where adopted, that we probably owe the confusion and manifest uncertainty of our knowledge in regard to the true nature of the great atmospheric currents.

but I do not intend, Mr. Editor, to weary the patience of your readers with a more prolonged chapter on the natural history of hurricanes, or to deprive the *savans* of their prerogative to dispose of our facts in such a manner as may seem best to accord with their favorite theories. Besides, our business at this time is rather with the facts themselves, than with their relations in a correct system of meteorology. It may be remarked however, that unless the writer has greatly mistaken the mass of evidence presented to his notice during the progress of his inquiries, these phenomena, as also the general winds in which they occur, are to be ascribed mainly to the mechanical gravitation of the atmosphere, as connected with the rotative and orbital movements of the earth's surface. But should any one, after an unbiassed and full consideration of the great facts which are now before us, and of their bearing as illustrative of the physics of the atmosphere, seriously ascribe them either to lunary, cometary, electric, or volcanic influence, or even to calorific agency in any just and proper sense, then the writer can only say, that he finds himself unable to explain these, and certain other phenomena of the atmosphere, upon such principles, and that he desires to concede all the honor of theorizing to those who may imagine that such relations can be established. It would promise better, however, to inquire whether we have not in these developments, a clue to the true system of atmospheric physics, a subject which has always been beset with difficulties, and to explain which we have hitherto obtained nothing better than plausible hypotheses.—In regard to the fall of the barometer, which attends these storms throughout their progress, its *rationale* is deemed to be so obvious as hardly to admit of question.

In conclusion, I will venture to hope that the facts and considerations now presented may prove, in some degree, useful to the nautical profession, and promotive also, of the general interests of science. At the same time it is hoped, that in future notices and reports of violent storms, more attention will be given to specific dates and location, and also to the direction and changes of the wind, all which may be expressed in the most summary manner; and the facts when once recorded, are for ever available, in tracing the progress and character of such storms. It seems desirable also, that the general route and character of European storms, should be investigated by those whose local position, and means of information, best qualify them for the task. The writer of this communication is but scantily furnished with materials for this object, and would gladly see the work accomplished by other and abler hands.

Art. IX.—*Rejoinder of* Prof. Shepard *to* Prof. Del Rio.

I regret being obliged to vindicate myself farther against the misapprehensions of Prof. Del Rio. It is a subject of much less concern, however, to find my system opposed by an individual whose long familiarity with mineralogy leaves no occasion for him to apply to analytical tables in the way of a learner, than to have its value called in question by that class of persons for whom it was expressly designed. Still I would not affect to be insensible to the good opinion of one so much my senior in the cultivation of this science, as must be a pupil of Werner; though I confess some surprise at the grounds on which he has seen fit to withhold his approval.

In the few remarks I have to make, I shall pursue the order of his observations on my reply, p. 384 of the last number of this Journal. He asserts that I could not have chosen a worse example than Rutile, as a mineral for testing the comparative merits of the two systems in dispute. He objects, because he is acquainted with no Rutile "which is fine granular, or impalpable." But I have no where said that Rutile occurs impalpable. My words were, *massive in small closely connected individuals.* I trust that these two conditions of mechanical composition are not confounded by Prof. Del Rio, since the difference is as great as that between snow and ice! Nor is the objection valid because fine granular Rutile does not exist, since it is a well known variety both at Arendal and the southern coast of Cornwall, besides occasionally occurring in the New England states. But if this variety were wholly unknown, the employment of Rutile to illustrate the characteristics in question, so far as relates to crystallized and easily cleavable individuals, would be perfectly suitable; though my rule for referring minerals to the semi-crystallized class, would but seldom allow the broken and imperfect crystals, and large granular varieties, to be determined in this class, for I have intended for it only such as are easily and distinctly cleavable, and such is not commonly the fact in Rutile, as any one may assure himself by attempting to cleave the Nigrine pebbles of Ohlapian. I must therefore be allowed still to persevere in recommending the pupil to determine Rutile in a great number of instances by a reference to the uncrystallized class, notwithstanding the remarks of Prof. Del Rio respecting the impossiblity of distinguishing it from Ostranite, if obliged to adhere to the princi-

ples I have advanced, which are very unaccountably supposed to preclude all regard to a difference of color and lustre between these species. My treatise however is very explicit in the definition of the natural properties of minerals, and in the enumeration of these properties among them. His assertion that I exclude color, fracture and lustre, from the list of natural properties, is farther proof of the hasty manner in which he has considered the subject of his criticisms; and has no better foundation than my having pronounced identical the three varieties of Galena proposed by him as a puzzle for the pupil using my book. These varieties were supposed to differ in structure: one of them is crystallized in the form of the cube, another massive in large individuals, and the third fine granular. How it is possible for these varieties to be identical in the sense of Natural History, will appear, if any one will peruse the remarks on Identity, § 104, p. 30 of my Treatise, and that without overlooking structure, color and lustre, as natural properties.

Prof. Del Rio is at a loss to understand how the frequent division of the species is a consequence, as I had asserted, of providing means for the determination of imperfect minerals. When any one will attempt to secure the object at which I aimed, in a manner equally effectual, he will probably comprehend the nature of the necessity. I intended by the remark, however, simply to say that I could not accomplish the task and avoid such a division. Should it be performed without involving this inconvenience, my assertion will be found untrue, and I shall cheerfully encounter the mortification it may occasion, for the sake of the improvement; though I must deny having triplicated (as charged by my reviewer) or even duplicated, the species by the process I have adopted.

Prof. Del Rio recommended the arrangement of Leucite, Analcime and Garnet under a new order, the trapezohedron. I had a right to conclude that this was done as likely, in his opinion, to lead the pupil to the names of these minerals with greater facility than on the disposition I had made of them. In adhering to my arrangement, therefore, I do not perceive the impropriety of saying, in reply, that it would lead to *no confusion*, provided I showed satisfactorily, as I trust I did, that none could occur.

I notice also with regret, that Prof. Del Rio adheres to his former assertion concerning the determination of Quartz, as included in my order of the rhomboid; and that he has become so extravagant as to deny that it ever presents itself under the figure of its primi-

tive form. A student who is even moderately acquainted with the connexion of forms, would be prevented by the difference of lustre on the pyramidal faces of most Quartz crystals, no less than by the striæ on the alternate faces of the prism, from referring them to the order of the regular hexagonal prism: and as to the fact of the primitive form being among the actual crystals of this species, it is abundantly mentioned as occurring at several places in Europe, by authors of the highest authority, and I should be extremely happy to show Professor Del Rio samples from Chesterfield, Mass. in my collection, (fig. 360, my Mineralogy, 2d part,) samples which, though not the unaltered rhomboid, are so far removed from the six sided prism, as to require an expert observer to detect in all instances even the rudiments of prismatic planes.

Had Prof. Del Rio been as explicit in his first review of my treatise, as he with some want of candor claims to have been in his notice of my reply, I should no doubt have extended my remarks in commenting upon the discoveries of Mitscherlich, in a manner more answerable to his expectations. The doctrine of *dimorphism,* I regard as too imperfectly established to justify any innovations among species founded on natural-history principles. Chemists may by making crystallizations in different menstrua and at various temperatures, obtain irreconcilable forms of what is supposed to be the same substance; they may fail also to detect any chemical difference between Flos-ferri and Calcareous Spar, and between White and Common Iron Pyrites; but still the interests of Mineralogy will not permit the union of these substances, differing as they do in crystalline form and other natural properties. The history of chemical analysis during the last twenty years, forbids such a procedure. The evidence of difference arising out of structure, specific gravity, hardness and lustre, must still be preferred to that derived from chemical analysis.

While the announcement that Arfwedson has just found 37 p. c. of sulphur in the European Manganblende, is a striking corroboration of the suspicious value I would attach to chemical analysis, I am compelled still to disagree with Prof. Del Rio respecting the identity of the Mexican variety with it as a species. The discrepancy of form, if real—so great as that of a cube and a rhomboid—is enough to induce me to make a mineralogical distinction.

The broken crystal with vertical planes, proposed as a dilemma for my characteristic, may contain such faces as to render it certain

that it belongs to the right square, the right rectangular, or to the doubly oblique, prism; but the probability is that it would be necessary to effect its determination through the 3d class.

To the inquiry how many characters may be considered as essential? (by which I suppose the question is asked how many of the natural properties are available as characters) I reply that structure, specific gravity, hardness and lustre, afford essential characters of full and perfect sufficiency for the distinction of classes, orders, genera and species, provided these groups are framed in accordance with the principles of Natural History.

CHARLES U. SHEPARD.

New Haven, Aug. 9, 1836.

ART. X.—*M. Alexandre Brongniart's New Work on the History of the Art of Pottery and of Vitrification.*

Museum to illustrate this subject.

In a letter to the editor, dated March 8th, 1836, M. Brongniart remarks: "I am much occupied with a work upon the history of the plastic art, or the art of pottery; and the requests which I take the liberty to annex, have for their object the enriching of a grand and instructive collection which I have formed at Sèvres, of every thing relative to the art of pottery, and consequently to the perfection of the work which I have undertaken, and of which I have published the plan in an extract from the article Pottery, in the Dictionary of Technology published at Paris. It forms the half of a volume, in which I have endeavored to present the principles of the art in a manner at once practical, philosophical and elementary. I am this year about taking a journey to England and to Germany, for the purpose of collecting information and specimens for this work and for the collection at Sèvres."

As this undertaking of M. Brongniart is important and interesting to science, to history, and to the highly useful and beautiful art of pottery, we publish a translation of the exposé entire, and strongly recommend it to the attention of all those who, in this country, have it in their power to promote the object in view. It is quite superfluous to add, that M. Brongniart's character furnishes every security for the able and faithful performance of the duty which he has undertaken.—*Ed.*

Sèvres, March 8th, 1836.

Royal Manufactory of Porcelain, and for painting on Glass.

UNITED STATES OF AMERICA.

Instructions as to the manner of co-operating towards the completion of the collection relative to the arts, connected with the manufacture of porcelain and with vitrification, founded at the Royal Manufactory at Sèvres near Paris.

I. What kinds of pottery are used by the different classes of inhabitants of the country; the agriculturists, the mechanics, citizens and merchants, poor and rich?

Is the pottery of native or foreign manufacture?

If foreign, from what country does it come, and in what way?

If of native manufacture, where is it made?

II. As to the native pottery, (and under this name we include all varieties, from the most common to porcelain,) it is desired to collect and procure specimens of every sort. Common pottery, both with and without glazing. Delftware common and Delftware fine. Pottery of brown free stone; crucibles. Varieties of porcelain. Bricks, both common and those manufactured by particular processes.

Plate species.—Plates, oval dishes.

Hollow ware.—Cups, salad dishes, tea and coffee cups.

Round pots, hollow moulded.—Oval and square pieces, saucers, boxes, &c.

The largest piece of each sort that is made.

The name given in the country to each piece.

The price of each piece upon the spot.

Whether there is exportation, and to what place.

III. Fabrication.

1. *Primary materials*—for the mass or paste. Clays. Marls or plastic earths which may be substituted for them. Sands. Rocks or stones. Limestone.

For the glaze or enamel.—If stony materials—feldspar-stones.

If metallic matters—Metals, their oxides, and metallic glass.

Exact localities from which these materials are drawn.

2. *Modelling.*—Moulds of plaster, of terra cotta or other materials of whatever kind.

The lathe and other instruments for fabrication.

Sketches, with exact dimensions of these instruments, if it is supposed that they differ from those used in Europe.

3. *Baking.*—Form of the ovens sketched, with the dimensions.

*Combustibles used, indicating them in the clearest manner possible.

IV. Information peculiar to the country.

1. To designate the principal manufactures of pottery, glass and porcelain in your vicinity.

2. Whether there is in North America, ancient pottery; that is to say, pottery fabricated in remote ages, and which has not been made for a long time. This pottery is found in general in alluvial soil, in the ruins of towns, and perhaps, as in some parts of Italy, and of South America, and of the oriental countries of the ancient world, in the graves or tumuli. In Europe, these things have often been admitted into museums as monuments of antiquity, but almost never as in relation to the art of pottery and its history. It is in this latter point of view that I regard them, and that I have collected a great number of the ancient pieces of pottery in the museum at Sèvres.

To endeavor to collect some pieces of this antique pottery, and to indicate exactly the place and the circumstances in which they have been found, and to endeavor to decide whether it had anciently any celebrity, always however mistrusting the deception of the sellers.

3. Whether there is knowledge from traditions, inscriptions, &c., that the natives (aborigines) of North America have ever fabricated or known glass.

General instructions in relation to the purchase, packing and forwarding of the objects collected.

The expenses which may be incurred in procuring the specimens and the information, will be reimbursed by the administration of the Royal Manufactory of Porcelain, upon the statement sent to the person who shall be designated to receive the amount.

It is expected that these expenses will not rise to a great amount: it is requested, in any event, that they may not exceed, in any one year, the sum granted, i. e. 200 francs for 1836, ($40); 200 for 1837; at least without a previous understanding with the administrator of the Royal Manufactory at Sèvres.

It will be necessary to pack the pieces with great care, and to consign them to a merchant in one of the ports of France, to be forwarded by way of slow transportation to the administrator of the Royal Manufacture of Porcelain; forwarding also the expenses of transportation.

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* The requests for information and for specimens, apply equally to glass manufactures and their productions.

It will be necessary that the correspondent at the seaport should write a letter of advice to the administrator of the Royal Manufactory at Sèvres near Paris, before the forwarding—that the latter may obtain from the director general of the customs, that the box may arrive under seal, *sous plomb*, and that it may not be opened at Paris: this is very important, to the end that there may be no derangement of labels, nor any breakage. It is equally important that the tickets which may indicate the places where the pieces were made, or those from which they come, should not be separated and mixed during the unpacking. It is desired therefore that they may be fastened either with glue, or with good wafers, or with twine.

Lastly, it is very desirable that there should be attached to the case a separate box, either of lead or of tin, or that there should be sent separately, notes, previously made, of the objects collected and forwarded; taking care that a correspondence be established between the objects and the notes, by means of numbers, which shall follow each other, or by numbering the series.

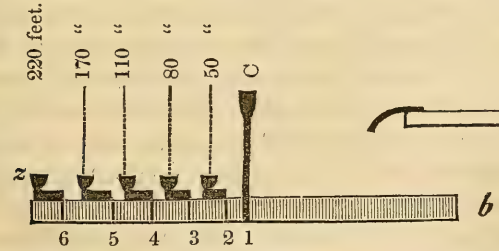
ALEXANDRE BRONGNIART.

ART. XI.—*Method of increasing shocks, and experiments, with Prof. Henry's apparatus for obtaining sparks and shocks from the Calorimotor;* by C. G. PAGE.

Salem, May 12th, 1836.

PROFESSOR SILLIMAN.

Dear Sir—I have lately constructed an apparatus for obtaining shocks from the calorimotor, which has furnished some curious results, and as you may perhaps, deem them worthy of publication, I send you herewith, a sectional drawing of the apparatus with a description.



The figure represents a section of an apparatus for obtaining shocks from the calorimotor. The coil of copper ribbon, contained in the box *b*, is 220 feet long, an inch wide, and has but four solderings or

joints, throughout its length. The separate lengths of 55 feet are cut from single sheets of copper. This is easily done by cutting the alternate strips within half an inch to the edge of the sheet, and then bending them one upon the other, to bring them in the same line of length; in this way the integrity of the circuit is better preserved than by numerous solderings. The ribbon is wound with single strips of list intervening. On five of the coils at distances indicated by the figure, are soldered strips of copper which pass through the cover of the box and are then bent down to receive the thimbles for the mercury. This forms a convenient arrangement, as the mercury cups are easily emptied by straightening the copper strips. *t*, represents the copper tube with a curved strip of copper soldered to its extremity for dipping into the mercury cups. For the sake of brevity in detailing the experiments, instead of the copper tube of right or left hand, merely the words right and left hand will be used; and by the abbreviations, neg. con. and pos. con. will be understood the strips of copper connecting the cups with the negative and positive cups of the calorimotor.

On putting the pos. con. into cup 1 and the neg. con. into cup 2, a bright spark and sharp snap are produced, when either of the connectors is raised from its cup. When the neg. con. is raised from cup 3, the spark is more brilliant than the last, accompanied with a louder snap.

When the neg. con. is raised from cup 4, the spark is more voluminous, but not so intense as the last named, nor is the snap so loud.

When the neg. con. is raised from cup 5, the spark is still less bright, and the snap less loud.

When the neg. con. is raised from cup 6, (220 feet,) the spark and snap are both feeble, even when compared with those given by cup 3. It would seem then from these results, that the limit* of intensity is attained at cup 4, which gives a length of 110 feet; but this inference is somewhat weakened by the following facts. The shocks by no means obey the same law; the maximum being obtained by immersing the copper tubes in cups 6 and 1. For convenience of arrangement, suppose the positive connector is in cup 1 and the right hand in cup 1. The left hand is to pass along with the neg. con. into cups 2, 3, 4, 5 and 6, and as the con. is raised from these cups successively, the shock increases, and from cup 6, is a

* This limit could be more accurately ascertained by having cups on each coil.

maximum with this apparatus. It will be seen from this, that from cup 4 to 6, the shock is inversely as the spark, while in the first half of the coil, it is in the same ratio. It may be well to mention here, that I found if the surface of the mercury, where the contact be broken, be covered with water, the shock is very much increased. The rationale I am unable to give, but such is the fact. This augmentation does not take place at every rupture of contact, but is best attained by striking the connector against the bottom of the cup and quickly raising it. The shock is also increased by covering the mercury with naphtha and the mercury appeared to be oxidized, the naphtha soon growing turbid.

The next results to be stated, are still more curious, and according to the received theories of electromotion, difficult to explain. The pos. con. and right hand are still in cup 1. The neg. con. in cup 2, and the left hand in cup 3, the shock is now stronger than when the left hand was in cup 2 with the connector, and the shock goes on increasing as the left hand is carried into cups 4, 5 and 6 in succession.* Let now the pos. con. and right hand remain in cup 1, place the neg. con. in cup 3, and the left hand in cup 4; the shock goes on increasing as before, and when the left hand arrives at cup 6, the shock is as strong as that obtained from the whole coil, (220 feet,) while the actual circuit from positive to negative, is only 80 feet. Let the pos. con. and right hand remain in cup 1, put the neg. con. in cup 4 and the left hand in cup 5; the shock is now as strong as when the whole coil is in the circuit, and when the left hand is in cup 6, the shock is stronger than can be obtained from the apparatus in any other way. These last results show that the real maximum as indicated by the shock, is given by the direct circuit from positive to negative, through half the coil, with the lateral cooperation of the other half.

Thus much being known, we might reasonably expect that while the connectors are in the extreme cups 1 and 6, we should obtain shocks from any two intermediate cups, and this I found to be the case; but contrary to expectation, I obtained shocks from cups entirely without the actual circuit. For instance the pos. con. in cup 1, neg. in 3, right hand in 4, and left hand in 6. In this case the shock was slight; but by thrusting needles into the thumb and fore finger of the left hand, and immersing the needles in cups 4 and 6, the shock was extremely painful.

* An assistant is necessary to make the immersion of the connectors.

Again, solder the copper tube of the left hand to the neg. con., put the pos. con. and right hand into cup 1. When the end of the neg. con. is raised from cup 4, no shock is felt, but when the other end is raised from the cup on the battery, a shock is felt. Other things remaining the same, carry the right hand from cup 1, out of the direct circuit into cup 6. Nearly the reverse of the last named phenomena takes place. A strong shock is felt when the end of the neg. con. is raised from cup 4, and a weaker one when the other end is raised from the cup on the battery. This experiment appears still more striking, when the right hand is carried into the same cup with the neg. con., cup 4; a shock is felt, although the distance by the direct circuit from hand to hand, is only about eight inches. Having detached the copper tube from the connector, put the pos. con. in cup 1, the neg. con. in cup 4, the right hand in cup 4, and the left hand in the neg. cup on the battery. It is immaterial now which end of the neg. con. is raised, both producing a shock. If the right hand is now carried to cup 6, the shock is a maximum.

A direct shock cannot be obtained from this instrument. To test this, I passed fine needles deep into the thumb and fore finger of the left hand, and immersed them in cup 6 and the neg. cup on the battery, the pos. con. being in cup 1; no shock was felt on making or breaking the circuit.

If a file or rasp be inserted into either of the cups and the connector drawn across it, the shocks become insupportable from their rapidity of succession. The scintillations from the file in this case are very beautiful, being by far the most brilliant and copious in cup 4. Very pleasing effects are produced by breaking the circuit with a revolving spur wheel. A little spur wheel of copper is so made, that in revolving, one spur shall leave the mercury before the next touches. In this way a rapid series of sparks and detonations are obtained. If bits of silver leaf are hung upon the spurs as the wheel revolves, the combustion of the silver leaf is very vivid, burning with its peculiar emerald light. The shocks produced while the wheel is revolving, are very disagreeable.

The decomposition of water was easily effected by breaking the circuit under its surface with two clean strips of copper. On using two small platinum wires, they adhered as with a deflagrator.

The coil was tried with a two quart Leyden jar, and shocks were obtained from cups entirely without the direct circuit. I refrain from stating other results with the Leyden jar, as they must be rendered somewhat equivocal, by the imperfect insulation of the coils.

It may also be worth mention, that by using the needles as before, I obtained with this apparatus, shocks from a single pair of plates of only four square inches, (single surface.) We have then in this instrument a battery by itself, from which shocks of all grades can be obtained, and in cases of the medical application of galvanism, it must prove far more convenient than the ordinary methods.

POSTSCRIPT. Salem, June 8, 1836.

One of the most pleasing experiments with the coil, is breaking the circuit with a revolving spur wheel. In former experiments, I produced the revolution of the wheel with a string, as in the wheel tinder box, having failed to effect it with a magnet. But I have since invigorated my calorimotor, by removing and cleansing the zinc plates, and a small horse shoe magnet is now sufficient to produce rapid revolutions, with the most brilliant results. The circuit in this case is terminated in cup 2, as the rotations diminish in proportion to the length of the coil used. The wheel is fitted with a wooden stand and trough, precisely as for magnetic rotation. The deflagration of the mercury is extremely vivid, giving copious fumes. If the experiment is performed in a dark room, it exhibits in a superb manner, the well known optical illusion, of a wheel in rapid motion appearing to be at rest. As the wheel is illuminated by a rapid series of sparks, it does not appear to be exactly at rest, but exhibits a quick vibratory movement. I have before alluded to the nature of the shocks given by the wheel, but with this self regulating apparatus, an assistant can be dispensed with, and shocks of any duration and degree, can be obtained, by immersing the copper handles as before directed. The strongest shock being obtained by immersing the copper handles in cups 6, and the negative cup on the battery. This last experiment is difficult to explain. The left hand being in cup 6, it is immaterial whether the right hand is carried to the positive or negative cup on the battery; a strong shock is felt in both cases, but that from the negative cup is somewhat stronger, and is the real maximum, if the circuit terminates with half the coil.

Art. XII.—*Observations on the Tails of Halley's Comet, as they appeared at Union College, Schenectady, N. Y., in Oct.* 1835; by Prof. B. F. Joslin.

Preliminary Remarks.—A comparison of the recorded appearances of comets with the known period of Halley's, has enabled astronomers, by identifying the latter, to trace back its existence for five or six hundred years. This circumstance renders this comet peculiarly interesting, as affording an opportunity of studying the physical changes which this class of bodies may undergo during long periods of time. These changes will be more accurately determined, in proportion as observers shall more particularly note those optical and other circumstances which affect their appearance, and especially the length of their trains.

It would appear from the former history of this comet, that at each of its periodical returns, since these have been recorded, the magnitude of its head, (which consists of the bright central part, called the *nucleus*, and the surrounding nebulous part, called the *envelope*,) and the length of its tail, have been observed to be less than at the preceding return. This has been attributed to a want of sufficient attraction to bring back to the head the material of the tail, and prevent its dissipation. In consequence of these successive degradations, astronomers generally anticipated, that in 1835, its tail, if seen at all, would be far less imposing than at any former period; and it was doubted by some, whether any part of the comet would be seen with the naked eye, or even without the aid of a powerful telescope.* Yet this *isolated* mass of *celestial* vapor appears still to be far from being entirely dissipated; although vapor, under ordinary *terrestrial* circumstances, is proverbial for its transitory character, and strikingly represents the brevity of human life. Yet this body, whose bulk consists chiefly of vapor; this body, at the same time among the lightest and most voluminous in the solar system, has (notwithstanding its alternate condensation and rarefaction, and its partial dissipation by solar influence) continued to exist, and to pursue its regular and prescribed (and now calculated) course through the heavens, at least during a period in which fifteen or twenty generations of men have been swept in succession from the face of the earth.

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* See American Almanac, for 1835.

The want of any satisfactory theory in relation to the tails of comets, and the changes which this particular one has undergone, render it more desirable to multiply exact observations of its apparent length, with an account of those circumstances by which it may have been affected.

The apparent length of this appendage depends, 1st, on its absolute length; 2d, on its distance from the earth; 3d, on its intrinsic brightness; for, as this fades away insensibly, the tail will appear to terminate where its light is too faint to make a sensible impression on the retina; 4th, on the brightness of the surrounding sky, in consequence of the illumination of the atmosphere by other light, as that of the sun or moon, which weakens the impression made by the light of the tail; 5th, on the altitude of the comet, and the opacity of the atmosphere, which intercepts and reflects more or less of this light; 6th, on the position of the optic axis; for although the figure and color of a bright object can be determined with more precision when the optic axis is directed towards it, the *existence* of a faintly luminous one can be more readily detected, and consequently the *extent* of one, whose brightness progressively diminishes from one extremity to the other, till it vanishes, can be more correctly determined by oblique or *indirect* vision, and when the optic axis makes a considerable angle with the visual ray of the object; and in all comparative estimates of its length, as seen at different times, or by different observers, it is necessary to know in which of these modes it was viewed. Lastly, telescopic vision, in which the field is comparatively of small extent, is necessarily direct; but the magnitude of a faint object will vary, not only with the magnifying powers, but with the diameters of the object glasses, provided they have proportional apertures.

There is one rare phenomenon, which, whenever it is presented, claims particular attention, viz. the second tail. I have hitherto alluded to the ordinary and proper one, which is nearly opposite the sun, and concerning the physical constitution of which the hypotheses have been numerous, but unsatisfactory. If it is owing to the atmosphere of the comet, driven off by the impulse of the sun's rays, how shall we account for several co-existent tails, some of them taking a very different direction? There is probably no phenomenon, which is destined in the progress of observation, to throw more light upon the physical constitution and rotatory motion of comets, than that of these supernumerary tails. The observation of some

of them may lead to the conclusion, that they are projected by local causes from particular parts of the comet's nucleus, and revolving with it, take at different times, different positions, a comparison of which may determine the period of rotation. In the account of my observations on Halley's comet, as well as in the following references to its former appearances, the term *tail* will, unless otherwise stated, be exclusively applied to the luminous train which was nearly opposite the sun. Whether in the accounts of its appearance previous to 1835, its total length was given, or only that part seen by direct vision, we may perhaps have no means of determining.

The comet of 1305, *believed* to have been that of Halley, seems to have presented an envelope and train, of such a magnitude as to render it not only sublime, but, in that age, terrific. It was referred to as the "cometa horrendæ magnitudinis," in an age when rare phenomena, instead of proving a stimulus to accurate observation, excited either wonder or terror. In the year 1456, it presented a tail 60° in length, and spread consternation throughout christian Europe. Its malign influences, in connexion with the Mahometan conquests, were daily and publicly deprecated, a papal bull being formally issued, and the church bells daily rung for that special purpose. In 1682, its tail was reduced to one half, being 30° in length. In the year 1705, Dr. Edmund Halley, having determined its period to be about seventy five or seventy six years, (varying according to the disturbing influence of the planets,) foretold its reappearance in 1759. It appeared within a month of the time predicted; and the fulfillment of this prediction, the first successful attempt of the kind ever made by astronomers, has liberated the human mind from those superstitious terrors, which hairy or blazing stars had always excited, and of which this comet in particular, had been for so many times, and in such a peculiar degree, the innocent cause.

Its next return to its perihelion, was in November, 1835, but a few days later in the month than was predicted.

The fact that the difference between the actual and calculated time, was much less than at the preceding return, evinces progress in astronomy. My own humble observations, however, to which I shall now proceed, have no bearing upon what, in the English use of the term, is called *physical* astronomy. They relate rather to the physics, and (if I may so express it) to the meteorology of comets; to points, which may interest the public and the natural philosopher, but not the student of celestial mechanics.

In the following observations, the largest telescope employed, was a five feet achromatic of Dollond's manufacture; magnifying power from 57 to 260; diameter of object glass, $3\frac{7}{8}$ inches. As it is not furnished with a micrometer, the magnitudes, positions, and forms of telescopic objects are to be considered as stated only approximately.

The smallest telescope, (except the finder,) was a portable telescope, having a magnifying power of 6.8; diameter of object glass, 2.6 inches; focal length, two feet three inches.

I shall, however, confine myself chiefly to an account of such observations as could be made with most advantage by simple vision, direct, and indirect; and more particularly to the length of the train. As this was generally more conspicuous in October, I shall confine the account to that month, although the train was afterwards seen. The following is a copy of my journal.

Observations.—Oct. 4, 4*h.* 15*m.* A. M. mean solar time. The tail of Halley's comet was distinctly seen with the naked eye, by indirect vision, but was invisible when the optic axis was directed towards it. It appeared to be nearly opposite to the Sun, but as it was very short, its position could not be satisfactorily determined. Its length, as seen indirectly, was equal to two or three diameters of the head. The apparent magnitude of the latter, as seen with the naked eye, was about equal to that of a star of the first magnitude, as dilated by irradiation, though its brightness did not exceed one of the third or fourth. The tail could only be seen in the absence of all foreign light, except that of the stars, though the head was visible to the naked eye, till within half an hour of Sun rise. With the five feet telescope, and lowest magnifying power, no tail could be seen, but only a rounded mass, resembling luminous vapor, increasing in brightness toward the center, near which the brightness increased so abruptly as to entitle this part to the appellation of a nucleus indistinctly defined.

Oct. 7.—The sky became clear at 5 A. M., and the comet was seen till 5*h.* 30*m.* as it was on the 4th, but no tail was detected. The light of the moon, (it being the day after full moon,) was at first the principal obstacle; afterwards, the dawn and a haziness conspired. On the morning of the 4th, when I detected the tail, the observation was made under the most favorable circumstances, *i. e.* at a considerable altitude, after the setting of the moon, and in a

sky neither rendered opake by vapors, nor bright by the reflected rays of the sun.

Oct. 8., *P. M.*—The comet seen, but so near the horizon, that nothing but the envelope was visible.

Oct. 9, 5*h.* 30*m. A. M.*—Thin clouds, the moon, and the dawn, conspired to render the tail invisible.

7 *P. M.*—The moon was below the horizon, but the comet being only about 18° above it, the distinctness of the tail, as seen with the naked eye, was not greater than on the morning of the 4th, yet by myself and several others, it was seen distinctly with the same telescope which was before used, as also with one of a less magnifying power, and greater comparative aperture. With the latter, which showed it more distinctly, it appeared as a faint brush of light extending about half way to *h* of Ursa Major, and was directed nearly towards that star. With the larger telescope, the nucleus was distinct.

Oct. 10*th*, 7*h.* 30*m. P. M.*—The moon had not risen, nor was any sensible portion of its light reflected from that part of the atmosphere which was in the direction of the comet. This body was about 4° farther from the horizon than at 7 o'clock on the preceding evening, and the tail more distinct; and, although this distinctness was afterwards diminished by the rising of the moon, and by the descent of the comet, in its diurnal revolution, yet there had been in 24 hours, an evident increase of brightness and length, as seen under similar circumstances as to terrestrial atmosphere. By indirect vision, it was about 3° in length. When the eye was fixed steadily on it, it nearly disappeared, as other faintly luminous objects do by direct vision. The length was still more reduced by the larger telescope, probably in consequence of the faintness of the object, and the smallness of the aperture of the telescope, compared with its magnifying power. The smaller telescope had not that effect.

Oct. 11*th*, 7*h.* 30*m. P. M.*—The train was very distinct. As seen obliquely, it intersected the line connecting κ and λ Draconis, at about one eighth the distance from the former to the latter. Seen by direct vision, it was very short. When at some distance from the axis of vision, it was usually seen with great distinctness, 8° or 9° in length; but occasionally, when the eye was in the most favorable position, its length was three times as great, *i. e.* between 24°

and 27°. After being dilated for a few (perhaps two or three) degrees from the head, it appeared to continue nearly of the same width to the extremity, the remoter half appearing to be rather narrower, and very faint. All the eye pieces were tried; also the finder, and the other small telescope. With the last, its apparent length was 8°; with the five feet telescope and lowest power, 1° in length, and still less, or invisible, with the higher powers. To the eye, there appeared to be a nucleus; but with the telescope, this seemed to be more like a vapor, still denser than the outer vapor, and to have a diameter about one eighth that of the whole head; but with the small telescope, from one fourth to one sixth. With the highest magnifying power, nothing but this central part could be seen, and that appeared rather as a mass of vapor, than a solid nucleus.

At 10 o'clock, some time after the moon had risen, and when the comet had descended nearer to the horizon, the tail was not seen by direct vision, and by indirect vision, its length was but 2°.

Oct. 12, 8*h*. 30*m*. *P. M.*—The tail appeared to be directed towards β Ursæ Minoris, and seemed to the naked eye about 9° in length. There was one remarkable circumstance in relation to its length, this evening, as compared with the preceding; which was, that *when viewed directly and intently, its length, brightness and constancy, were found to have increased, whilst the total length, as seen by indirect vision, was not half as great as on the preceding evening.* That long, faint, white, and straight beam of equable width, which on the preceding evening, had stretched across the heavens like an auroral streamer, was now, as it were, cut off near the place where it joined the more obvious part. These were the phenomena of simple vision; and nothing remarkable was seen with the portable telescope.

But at 8*h*. 40*m*. on directing the larger telescope, furnished with the eye piece of lowest magnifying power, I discovered a kind of *supernumerary tail.* The nebulous matter seemed to have been in in a great measure, accumulated on the lower side of the brightest part, or nucleus, and to have formed a very distinct and regular conical brush of light, the axis of which was directed downwards, and a little to the right, making an angle of about 120° with the long tail before described. The length of this new tail was equal to about three times the diameter of what I have called the nucleus, having the breadth of the nucleus at the part next to it, and about

twice that breadth at its remote extremity. The opposite sides were inclined at an angle of about 20° ; *i. e.* considering it as a frustum of a cone, the angle at the imaginary vertex was about twenty degrees.

Although with such a telescope there can be but little irradiation, compared with that in simple vision, I at the first moment suspected that it might possibly be an illusion of that kind ; but having observed, as was stated in my memoir on that subject,* that the directions of the beams produced by this cause, have certain determinate positions with respect to the position of the head, and are consequently changed with its inclinations, I soon discovered that this brush of light was not in any one of the directions of maximum irradiation ; and on my inclining the head to the right and left, the position of the beam, which I now concluded to be a real tail, remained constant. But for more perfect assurance, I removed the day tube, which had been hitherto employed, and which showed objects erect, and applied in succession two other eye pieces, both of which inverted, and one of them was of the highest magnifying power, *i. e.* 260. The new tail was seen with these glasses with no less distinctness, but appeared to be exactly in the opposite direction, just as it should be if real. The object glass was also rotated, without producing any change in the tail. The foregoing observations were completed about the time of the rising of the moon, more than half of whose visible disk was, at that time in the month, illuminated. About an hour and a quarter after it had risen, the comet, as seen with the naked eye, presented but a very short tail ; its long one being, as it were, shorn off by the moonlight, to a length equal only to three times the diameter of the head ; *i. e.* about the same length, compared with the diameter of the nebulous envelope, as that of the telescopic short one, compared with the diameter of the telescopic nucleus.

Oct. 13.—The atmosphere during the day and evening has been smoky. This opacity has prevented a good view of the comet this evening. The tail, as seen with the naked eye, appears not more than 3° in length. The eye-piece for land objects gives no distinct view through the smoke, on account of the number of glasses. With the lowest magnifying power of the others, which invert, the nucleus appears situated as last night, in the lower and right part of

* Transactions of the American Philosophical Society, vol. iv. new series.

the head; *i. e.* it is really in the upper and left part. What appeared as a short tail, in a clear sky, appears through the smoke as an eccentric envelope, this term being applied to the nebulous matter which surrounds the nucleus. The angle which the supernumerary tail makes with the other, is not greater to-night than it was last night. On account of the smoke, the angle cannot be so exactly determined, but is between 100° and 120°. As seen through this eye-piece, the luminous matter on the lower right side of the nucleus appears to-night to *extend three or four times as far from the nucleus as it did last evening*, when it appeared more distinctly as a tail. By the use of the term *nucleus*, I do not mean to affirm, that any solid body was seen, but to express a small bright spot, whose brightness had, on all sides, an abrupt termination, and did not fade away into that of the exterior of the head, by insensible degrees. Those students generally who used the telescope this evening, perceived the eccentric situation of the nucleus. I perceived the same after having taken the telescope from the stand, and placed the lower side uppermost. I consider my conclusion in regard to the existence of a supernumerary tail confirmed. The longer tail is directed toward β Cephei.

Oct. 14.—The tail, at 8 P. M., was directed nearly towards τ Herculis. The opacity of the air, which appears to be of the same nature as that which frequently prevails in this country in the latter part of autumn, and which is called Indian summer, tends much to obscure the comet this evening. To the naked eye, the tail is about 6° or 8° in length, and from 12° to 16°, as seen obliquely.

The nucleus cannot be seen with the eye tube for terrestrial objects, nor with that of the highest magnifying powers, and but faintly with the two intermediate powers, but more distinctly with the higher of these two. On account of this indistinctness, it is difficult to determine exactly the direction of the supernumerary tail, or (if any one prefers the expression) on which side the nebulous envelope is very much condensed and elongated. But if I might hazard an opinion, the nebulous matter at about 8 or 9 o'clock appeared to be elongated downwards in a direction making an angle of perhaps 160° or 170° with the long train. That it was elongated downwards in some direction was evident; the precise direction being rather uncertain.

Oct. 15.—The clouds and a kind of fog this evening prevented a good view. The length of the tail appeared less than 2°; its direction was towards the star ζ in the constellation Hercules.

Oct. 16, 7 *P. M.*—This evening the *sky is clear*, and the comet is seen very *distinctly*. The condensed nebulous matter which radiates from the comet on one side, and which, for the sake of distinction, I call *the short tail, is very distinct, and forms a longer and less acute cone than it did when first seen;* its length being equal to about six times the diameter of the nucleus, and its sides diverging at an angle of about 60°; and outside of these and contiguous to them, are fainter portions at an angle of about 90° with each other; so that, considering this tail as a frustum of a cone, the parts within 30° of the axis are bright; beyond that the tail is faint, yet visible to the extent of 45° on each side of the axis of the cone. These are to be understood as the observed angles; the actual angles being somewhat less, if the axis of the cone is oblique to the visual ray. This cone seems, when viewed with the large telescope, to constitute nearly all the envelope then visible. It would seem that the outermost envelope seen with the naked eye, is not seen with this telescope, because it is too faintly luminous, and that this short fan-like tail is not seen with the naked eye, because it has not sufficient magnitude. I infer this want of identity in the visible envelope in the two cases, not merely from the dissimilarity in shape, but from their relative apparent magnitudes; for the telescopic, concentrated and radiated envelope, appears, (I should judge,) even smaller than the whole head, as seen with the naked eye. Had it appeared magnified by the telescope, we might have attributed the difference of shape in part to irradiation, most of which would be removed by the telescope.

At 8 o'clock, the axis of this conical tail, or the middle radius of its projection, considered as a circular sector, is directed downwards, and to the right, making an angle of about 161° (as I judged) with the proper tail. The latter passed exactly through the star θ in the knee of Hercules. The small tail was seen with all the eye glasses, also with the tube of the telescope inverted. It was seen by many of the students, as well as by myself. The long tail, as seen with the naked eye, did not appear to increase in breadth for more than three or four degrees from the head of the comet, and the part seen constantly by direct vision, may have been 7° or 8° in length; but *seen by indirect vision, it extended forty five degrees in length,* stretching across the heavens nearly to the milky way.

Oct. 17.—The tail, seen directly, this evening, is usually about 3° in length; its width at that distance is about twice as great as

at the place where it joins the head. At the latter place, its width appears to be about two thirds that of the head. The head appears rather larger, though fainter, than a star of the first magnitude. That part of the tail seen by indirect vision, the faint, narrow and apparently straight tail of equable width, extends into the constellation Lyra: the length of the whole tail is about *thirty five degrees*, which is 10° less than last evening. The sky is much less clear than on last night, and the envelope condensed on one side to form the short tail is indistinct, yet its direction and form seem not to have been sensibly changed since last evening.

Oct. 18, 7 *P. M.*—Tail as seen with the naked eye fixed steadily on it, 9° in length; by indirect vision, about 18°. *Seen directly it is longer, and indirectly, shorter than it was on the* 16*th.* The atmosphere appears to be less clear. In consequence of this, and of the wind, the nucleus is not discernible.

Oct. 19, 7*h.* 30*m.* *P. M.*—Length by direct vision, about 6°; by indirect vision, about 18°: sky clear near it at the time. It being windy and cloudy, the large telescope was not taken out.

Oct. 22, 7 *P. M.*—Tail directed to β Serpentarii; length by indirect vision about 9°, by direct vision about 2° 30′. Nucleus not discernible.

Oct. 23.—Tail fainter than on the preceding evening.

Oct. 24, 7 *P. M.*—Length as seen by indirect vision, about 12°; by direct vision, about 3°. The sky is quite clear; but there is considerable wind. It is probably owing to this circumstance, and to the comet's distance, and to its small altitude after the disappearance of the moon and twilight, that the nucleus could not, this evening, be seen with sufficient distinctness to enable me to determine on which side of it the nebulous matter was most dense and elongated. If the nucleus was seen, it must have been somewhere near the upper part.

Oct. 25, *Evening.*—Tail directed about towards α Aquilæ; length by indirect vision, about 3°; by direct vision about 30′. The sky is clear and the air still, but there is a new moon. The head appears to the naked eye about as large as a star of the second magnitude. A kind of nucleus is visible with the telescope, with which the tail and envelope are also distinctly seen.

I am inclined to think that there have been seen at different times, two apparent nuclei of different orders; and that the smallest one, seen when the comet was nearer, had a situation at one extremity

of the one now seen; and that this which is now seen would, if it were nearer to the earth, appear to constitute a kind of tail to the other. Yet, notwithstanding the indistinctness arising from distance, the head of the comet I should judge to be brighter than it was two weeks since.

Concluding remarks.—Length of the tail by direct and indirect vision.—It appears from the preceding observations, that on those days in October in which the length of the tail was observed in these two modes, its *mean length by direct vision, was* 5° ; *by indirect vision,* 17½ *degrees ; i. e. as one to three and a half.** In a majority of instances, the length by indirect vision was between two and four times that by direct vision.

Now the tails of some comets are said to have exhibited instantaneous variations in length, like the coruscations of an aurora borealis; and this circumstance has led some astronomers to consider them of an electrical nature. But has not this phenomenon been rather *physiological* than physical? Has it not been chiefly occasioned by a change in the position of the eye? The other hypothesis presents insuperable difficulties, when we consider the distances of comets, and the immense velocity with which electricity must move, to produce any sensible and sudden variation of length, at such distances from the observer. It will be seen from the preceding observations, that immense and instantaneous variations of length were observable by us at almost any time when the tail was visible. They were observed hundreds of times; so that a tail eight or ten millions of miles in length, would frequently become in a second of time twenty or thirty millions.

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* Length of tail by direct vision.		By indirect vision.	State of the air.
Oct. 10th,	0° 10′	3° 0′	Transparent.
11	8 30	25 30	do.
12	9 00	9 30	do.
14	7 00	14 00	Opake.
16	7 30	45 00	Transparent.
17	3 00	35 00	Opake.
18	9 00	18 00	Less transparent than on 16th.
19	6 00	18 00	Tolerably transparent.
22	2 00	9 30	Rather opake.
24	3 00	12 00	Transparent.
25	0 30	3 00	Transparent, with new moon.
Mean lengths, 1:3.5, i. e.	5°	17.5°	

Again, in estimating the rapidity with which a comet's tail is developed, we are liable to err, from a neglect of *meteorological*, as well as physiological influences. Estimates have been made in relation to the number of millions of miles to which the matter of a comet's tail has been projected, during the interval between the observations on two consecutive nights. By overlooking or underestimating the immense influence, which slight changes in the transparency of the atmosphere must have on the apparent length of such faintly luminous bodies, we might draw from several of the preceding observations, astonishing conclusions with regard to the velocity with which this luminous matter is projected. We might thus infer the projection of luminous matter to the extent of fifteen or twenty millions of miles in a single day; for the tail of Halley's comet, according to some of the preceding observations, must have appeared to receive such an augmentation of length in a single day.* The greatest observed length was real, and indeed from the gradual manner in which the brightness diminished, it must have been less than the actual length. *It is not improbable, from the length of the tail at different altitudes, that, in the absence of terrestrial atmosphere, it would have presented a length of some hundreds of millions of miles.* Even the part actually seen on the 16th, if it had been directed toward the earth at the time of the comet's nearest approach, must have nearly reached us, and by gravitation, (if it were ponderable,) mingled with our atmosphere. What effects may sometimes be produced in the planetary atmospheres in this way, is not known.

By what has been said in relation to sources of exaggeration, respecting this developement in length, it is not intended to deny that it does take place with astonishing rapidity, as comets approach the sun. This has been often observed.

Direction of the principal tail.—By referring to those of the preceding observations, made when the direction of the tail was seen, and its place among the stars recorded, it will be found that it was never directly opposite the sun, but always inclined towards the region from which the comet was departing. This was always the case when the position was observed and recorded, as it was on ten

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* The angular lengths above given would, with the comet's place in its orbit, enable one to calculate the absolute lengths; but what has been said above in relation to this last point, has been founded only on hasty and approximate estimates.

evenings, from the 11th to the 25th Oct. inclusive.* It was formerly believed that the tail of a comet was in most cases directly opposite to the sun ; but modern observers have discovered that it is generally inclined a little backwards. This has been attributed by some, to the resistance of an ethereal medium ; but that curvature which would naturally be produced by this cause, and which has been often observed in these luminous trains, was not in this instance detected. The straightness of a tail of such immense length and levity, appears to be rather unfavorable to that hypothesis. If there was any curvature, (which was once suspected,) it must (I should think) have been less than would be due to that cause, according to that hypothesis.

Nucleus and Envelopes.—What I remarked in my journal in relation to apparent nuclei of different orders, is equivalent to the expression, that there are real envelopes of different orders, the less brilliant one being at the greater distance. This is analogous to the results of former observations, which have detected, in the case of other comets, two or more concentric envelopes, as though there were different strata of luminous clouds at different heights in the comet's atmosphere, with intermediate aëriform matter, uncondensed and transparent.

The difference in this instance was, that the envelopes were not always concentric ; in other words, that there was a kind of

Second Tail.—This was a *tail to the nucleus, but not to the exterior envelope :* in this respect, it differed from the ordinary train. In being equal in width to the nucleus at the part where it joined it, and in diverging from it, it sustained about the same relation to the nucleus, as was sustained to the whole head by that part of the longer tail which joined it, although there was no neck or contraction of the shorter tail near the nucleus. When the sky was clear, it was not circular or elliptical, but presented the appearance of a circular sector, with straight divergent sides ; so that analogy justifies us in calling it a tail. Indeed, this term might be applied to any stream of diverging light, even were the analogy less complete. And even though a stratum of it may have surrounded the real nucleus, this would be analogous to the case of the ordinary tail, for it passes

* This was the case according to the situation of the comet, as observed by me ; and although I had not the means of determining the place of the head with great exactness, yet the declination was usually greater than that which would be likely to arise from an error of that kind, which error, moreover, would not have been always on the same side.

in a kind of parabolic form around the telescopic envelope, to form the outer envelope, which is visible to the naked eye, and which appears to be contiguous to the tail, and similar to it in brightness, but not contiguous or similar to the envelope within. I have endeavored to describe these objects as they appeared with our telescope. To those who enjoyed the advantage of more powerful instruments, other minute and faint parts must have been detected, whose existence may have affected the general form ; but this circumstance may not destroy the value of the above observations, as the descriptions might still be found tolerably correct, so far as regards parts within certain limits of magnitude and brightness.

Those who are familiar with the history of astronomy, know that double tails are not unprecedented.

Several tails have been seen attached to a single comet. That of 1744 presented six streams of nearly 30° in length, widely divergent, like the rays of an expanded fan.

In January, 1823, Prof. Biela, at Prague, and President Day, at New Haven, saw a second tail at an angle of about 178° with the first. It was seen but for a few days, and not many particulars in regard to it are stated. But it would seem that this tail, like most of those seen previous to 1835, proceeded rather from the envelope than from the nucleus.

In July, 1825, Mr. James Dunlop, astronomer, at Paramatta, New South Wales, observed the changes of position and form which occurred in the tails of a comet, and afforded evidence of the existence of a rotatory motion in the comet, the approximate period being 19 *h.* 36 *m.* His observations, which were exact and minute, were published by Sir Thomas Brisbane.

The preceding observations on Halley's comet, will perhaps be thought to justify the suspicion of a rotation, but its period cannot be determined by them with exactness, nor its existence with certainty, without comparing them with others made in a clearer sky, with more powerful instruments, and on nights, and at hours, differing from those of my observations.

As this is a phenomenon which is usually seen but for a few days, and as the sky may be clear at one place, and cloudy at another, at times when it exists, the foregoing observations may afford data of some use in the investigation of this interesting subject, although they cannot be put in competition with simultaneous observations, made under more advantageous circumstances.

ART. XIII.—*Solutions of two diophantine Problems; by* Prof. THEODORE STRONG.

QU. 1. To divide unity into three positive parts, such that if each is increased by unity, each sum shall be a rational cube. Assume z, $p+q$, $p-q$, for the roots of three cubes, such that their sum shall equal 4, and each cube shall be greater than unity, then by subtracting unity from each of these cubes, we shall evidently have the numbers required. Hence, we have $z^3+(p+q)^3+(p-q)^3=z^3+2p^3+6pq^2=4$, which gives $q^2=\frac{4-z^3-2p^3}{6p}=\frac{24p-6pz^3-12p^4}{36p^2}$, hence, we must make $24p-6pz^3-12p^4=$ to a sq. (1.) Put $p=\frac{6}{5}-yx$, $z=\frac{4}{5}+vx$ then (1) becomes $\frac{144}{625}+\frac{24}{125}(323y-72v)x+\frac{144}{25}(2vy-3v^2-18y^2)x^2+\frac{36}{5}(8y^3+2yv^2-v^3)x^3+6(yv^3-2y^4)x^4=$ sq. $=\left(\frac{12}{25}+\left(\frac{323y-72v}{5}\right)x+ax^2\right)^2=\frac{144}{625}+\frac{24}{125}(323y-72v)x+\left(\left(\frac{323y-72v}{5}\right)^2+\frac{24a}{25}\right)x^2+\left(\frac{646y-144v}{5}\right)ax^3+a^2x^4$, by assumption; $\therefore$ by reduction, and putting the coefficients of x^2 equal to each other, we shall have $a=\frac{46800vy-5616v^2-106921y^2}{24}$, (a) then $x=\frac{288y^3+72yv^2-36v^3-646ay+144av}{5(a^2+12y^4-6yv^3)}$, (b), these equations will enable us to solve the problem as required. Assume $y=1$, $v=\frac{17}{5}$, then by (a) we get $a=\frac{318049}{600}$, and by (b) we have $x=\frac{29739653520}{505372948805}$, $\therefore z=\frac{4}{5}+vx=\frac{505413181012}{505372948805}$, and $p=\frac{6}{5}-yx=\frac{576707885046}{505372948805}$; also, since $q=\pm\left(\frac{12}{25}+\left(\frac{323y-72v}{5}\right)x+ax^2\right)\div 6p$, by taking the sign $-$ we easily get $q=\frac{2}{5}\times\frac{92644218793282625291 55}{576707885046\times 101074589761}$, hence, $p+q=\frac{566270943093850697}{470040809835196035}$, & $p-q=\frac{506506070263707307}{470040809835196035}$, these and the value of z found above are the roots of the required cubes.

Remarks.—This question was proposed in the Mathematical Diary, in 1832, and the above is the solution which I sent to the editor at that time, to be inserted in the following number of that work, but as the Diary has not been published since, and probably will not be resumed, and as several persons have expressed a desire to see the solution of the question, I have concluded to publish it in the Am. Journal of Science.

Qu. 2. To divide any rational number into three rational cubes. Let a denote the given number, and x, $p-x$, $m-p$, the roots of the required cubes, then we shall have $x^3+(p-x)^3+(m-p)^3=3px^2-3p^2x+m^3-3m^2p+3mp^2=a$, or $3px^2-3p^2x=a-m^3+3m^2p-3mp^2$, hence, we have $36p^2x^2-36p^3x+9p^4=(3p^2-6px)^2=12ap-12pm^3+9p^2(p-2m)^2=$ a square (1). Assume $9p^2(p-2m)^2-12pm^3+12ap=[3p(p-2m)+2c]^2=9p^2(p-2m)^2+12pc(p-2m)+4c^2$, (2), or by reduction, we have $c^2+3pc(p-2m)=3ap-3pm^3$, (3), this equation is satisfied by assuming $p=\frac{c^2}{3a}$ and $m^3=c(2m-p)=c\left(2m-\frac{c^2}{3a}\right)$, $\therefore$ put $c=mn$ and the last of these gives $m=\frac{6an}{3a+n^3}$, hence, $p=\frac{12an^4}{(3a+n^3)^2}$, $\therefore m-p=\frac{18a^2n-6an^4}{(3a+n^3)^2}$. Also, by (1) and (2) we shall have $3p^2-6px=3p(p-2m)+2c$, $\therefore x=\frac{30an^3-n^6-9a^2}{6n^2(3a+n^3)}$, and we shall have $p-x=\frac{72an^6+(9a^2+n^6-30an^3)\times(3a+n^3)}{6n^2(3a+n^3)^2}$, these and the value of $m-p$ found above, are the roots of the sought cubes, which will be exhibited under a more general form by putting $n=\frac{r}{t}$; but as the reductions which this substitution requires are obvious, we shall not insert them. If $a=4$, then by assuming $n=2$, we shall have $\frac{144}{300}$, $\frac{470}{300}$, $\frac{106}{300}$, for the three roots, and by adding their cubes, we shall find that the sum $=4$, as it ought to do. Cor. If we wish to divide any given number as a, into two cubes, then by assuming x, $p-x$, for the roots of the cubes, we shall get $(3p^2-6px)^2=12ap-3p^4=$sq., but this evidently requires one answer to be found by trial, which cannot always be done, as is the case when a is a cube number; but if one answer can be found, then we can readily find as many others as we please by the ordinary methods. If we wish to divide a, into any number of cubes greater than two,

assume $x, p-x, m-p, r, s, t$, &c. for the roots of the cubes, then by proceeding as in the question, we shall have $(3p^2-6px)^2=9p^2(p-2m)^2+12ap-12p(m^3+r^3+s^3+$, &c.$=$ sq. $=[3p(p-2m)+2c]^2=9p^2(p-2m)^2+12pc(p-2m)+4c^2$, then as in the qu. $p=\frac{c^2}{3a}$, $c(2m-p)=c\left(2m-\frac{c^2}{3a}\right)=m^3+r^3+s^3+$, &c. put $c=mn$, $r=mr'$, $s=ms'$, &c. $\therefore$ we shall have $m=\frac{6an}{3a+n^3+r'^3+s'^3+,\text{ \&c.}}$, hence, $p=\frac{12an^4}{(3a+n^3+r'^3+s'^3+,\text{ \&c.})^2}$, and $m-p=\frac{18a^2n-6an^4+6an(r'^3+s'^3+,\text{ \&c.})}{(3a+n^3+r'^3+s'^3+,\text{ \&c.})^2}$, $r=mr'=\frac{6anr'}{3a+n^3+r'^3+s'^3+,\text{ \&c.}}$, $s=ms'=\frac{6ans'}{3a+n^3+r'^3+s'^3+,\text{ \&c.}}$, and so on; we also have $x=m-\frac{c}{3p}=m-\frac{a}{c}=m-\frac{a}{mn}=\frac{6an}{3a+n^3+r'^3+,\text{ \&c.}}-\frac{(3a+n^3+r'^3+,\text{ \&c.})}{6n^2}=\frac{36an^3-(3a+n^3+r'^3+,\text{ \&c.})^2}{6n^2(3a+n^3+r'^3+,\text{ \&c.}}$, and $p-x=\frac{72an^6+[(3a+n^3+r'^3+,\text{ \&c.})^2-36an^3]\times(3a+n^3+r'^3+,\text{\&c.})}{6n^2(3a+n^3+r'^3+,\text{ \&c.})^2}$, which with the values found above, are the roots of the required cubes.

New Brunswick, Aug. 3, 1836.

MISCELLANIES.

FOREIGN AND DOMESTIC.

ASTRONOMY.

Supposed new Planet.—On the 15th of February, M. Arago read to the Academy of Sciences an extract of a letter from M. Cacciatore, Astronomer at Palermo, to Capt. Smyth. The Sicilian Astronomer announces in this letter, that he saw in the month of May, 1835, near the 17th star of the 12th hour of the Catalogue of Piazzi, (right ascension 181° 30′, and southern declination 4° 45′,) another star of the 7th or 8th magnitude. Having taken the distance of the two stars, he found that in three days the distance had increased. The motion of the star was about ten seconds of

right ascension on the eastern side, and a minute or a little less towards the north. In consequence of the state of the weather, he could not succeed in tracing it. From the slowness of its motion, he conceives it must be situated beyond Herschel.—*Bib. Univ. Jan.* 1836—*Rec. Gen. Sc. June,* 1836.

NATURAL PHILOSOPHY.

1. *On Electricity by contact, by* KARSTEN; 8vo. Berlin, (in German.)—The following are some of the most important results to which M. Karsten has been led by his investigations.

1. Metals, and perhaps all solid bodies, become positive in fluids, while the fluid in which they may be immersed, is negatively electrified.

2. A solid, immersed one half in a fluid, acquires polarity; the part not immersed being negative, while the other part is positive.

3. Solid bodies differ in their electro-motive force in the same fluid, and this difference is the cause of the electric, chemical and magnetic attraction in the galvanic circuit.

4. If two solid electro-motors, of different electro-motive force, are immersed in the same fluid without being in contact, the most feeble electro-motor receives a different polarity from the stronger, and becomes consequently negatively electric.

5. The part of the most feeble electro-motor, not immersed, manifests opposite electricity to the part in the fluid, that is, manifests positive electricity.

6. The electro-motive electricity of a fluid, depends on the property of being reduced by two solid electro-motors of dissimilar strength, to such a state, that the solid electro-motors receive opposite electricities. In general, all fluids which are bad conductors of electricity possess this property, and not those which are good conductors, or those which have no conducting power. The intensity, however, of the electro-motive force of the fluids depends not solely on the conductibility, but on other properties, not fully known.

7. The electro-motive effects of two metals which form a circuit in the same fluid, depend on the continual excitement and neutralization of the opposing electricities in the fluid. They are generated by the electro-motive action of the stronger and weaker electro-motor on the fluid; are augmented by the action of the stronger on the weaker; and are accelerated by the close contact of two solid electro-motors, when these are good conductors.

8. The chemical changes in the fluid, depend on the neutralization of the two electricities, produced by the solid elements of the circuit, but these changes have not the mutual relation of cause and effect.

9. In the system of circuits composing the voltaic pile, the opposite electricities are completely neutralized by the solid elements of each circuit, that is, by the pairs of plates, and there is no electric current from one pair to the other.—*L'Institut, No.* 150.

2. *Effects of Electricity on Vegetation.*—M. Baric states, that "last year, in the month of July, the lightning struck one of the poplars in my avenue—the fluid breaking off at the time a few branches at the summit of the tree, followed down the tree without breaking the bark, and at last passed into the earth, throwing up two cubic feet of earth. The poplar at the time was about a foot in circumference: at the present time it is double that size, whilst those near by have made no perceptible increase in size.—*L'Institut, No.* 155.

3. *Chemical Action of the Solar Spectrum,* by M. Hessler.—Professor Hessler, of Gratz, has found that the action of the solar spectrum on paper which has been moistened with a solution of gum, and sprinkled with chloride of silver, varied with the nature of the prism. The action differed both in the extent and rapidity of its effect, and also in the point of the spectrum where it attained its maximum. It was nearly instantaneous with a prism of water or spirits of wine; occurred in the course of 12 or 13 minutes with oil of terebenthine and cassia; in 2 minutes and 3 seconds with flint glass, and 1 minute 5 seconds with crown glass. The maximum chemical effect with spirits of wine, was obtained in the violet near the blue; with water, in the violet; with oil of cassia, 23 lines outside of the violet.—*Annalen der Phys. und Chem.* 1835, *No.* 8.—*L'Institut, No.* 152.

4. *Theory of the Universe,* by P. E. Morin. (Introduction à une Théorie Générale de L'Univers. Par P. E. Morin. 44 pp. 8vo. Paris.)—This author has generalized his singular views, the result of from 15 to 20 years' deliberation, as follows: "That the universe is composed of centres of action, which attract or repel in a ratio inversely as the square of the distance; that the contact of any

body with the living fibre causes the fibre to vibrate; that this vibration diminishes in proportion to the number of contacts; that when an organized body is directed by instinct or reason, either pleasure, pain or ennui, result; that pleasure is a consequence of vibrations of mean or ordinary strength—pain, when the strength is greater than usual, and ennui when the vibrations are quite feeble." These principles form the groundwork of a theory, on which all the phenomena of nature are to be explained.

5. *Congelation of Mercury by Natural Cold.—Extracts from a minute of observations on freezing Mercury in the open air, made at Gardiner, Maine, January 28th and 29th,* 1817.—The whole of the day of the 28th, was intensely cold. At 2, P. M. the thermometer hanging on the wall of a house stood at $-6°$. About sunset the wind subsided.

A tray of charcoal was placed upon the end of a wharf projecting into the Kennebeck, nearly a hundred yards from any building or other elevated object. On this was placed a thermometer in a blackened tin case, and two phials each containing a small quantity of mercury, the lower half of each phial being blackened, and the phial a little raised from a horizontal position, so that the fluid might be within the blackened part. A similar phial of mercury was placed on the snow at a little distance; but as it underwent no change, no farther notice was taken of it.

At 10 o'clock in the evening, the thermometer stood at $-29°$. The sky was perfectly serene and clear. At half past 11, the thermometer had fallen to $-32°$. At half past 3, (the 29th,) the thermometer was at $-38°$; the mercury in the phials of course still fluid. The atmosphere was remarkably transparent and perfectly calm. At half past 6, the thermometer stood at $-40°$. It soon rose one degree while we were bending over to examine it—the mercury in the phials still fluid. I now poured out a small quantity of the mercury into an excavation in a piece of charcoal. At $\frac{1}{4}$ before 7, the thermometer was again at $-40°$; the mercury in the phials still fluid; but that on the charcoal was partially congealed. As I examined it with a slender stick, it exhibited the appearance of a soft solid, separating into parts without running into globules; and the fragments were rough, and evidently crystalline. These appearances, however, continued only a short time; but while I was examining it, being of course necessarily bent over it, the whole soon

returned to a perfectly fluid state. At 7 o'clock, the thermometer was still as before at $-40°$. The mercury in the phials was unchanged. That on the piece of charcoal exhibited the same appearances as at the last observation, only in a less marked degree, and it sooner became fluid. Soon after this, the sun rose, and of course the attempt was discontinued.

To Prof. Silliman.—*Dear Sir,*—I send you above, the extract from my minutes of an observation of the effect of natural cold on mercury, on the Kennebeck. A few weeks later, having been supplied by the kindness of the late Mr. Vaughan with several excellent thermometers of Troughton's manufacture, I attempted to ascertain how much effect was attributable to the cooling of the surface by radiation, in a similar state of atmosphere: and on one occasion found a difference of 18 degrees between a thermometer on charcoal on the ground, and another suspended freely in the air, 18 or 20 feet above it—one being 36°, the other 18° below zero. This was in a clear night, and subsequently when clouds appeared, the difference diminished, until at the commencement of snow the two instruments agreed. Yours very truly,

E. Hall, Jr.

Boston, Wednesday Evening, March 23, 1836.

CHEMISTRY.

1. *Cause of Decrepitation;* by M. Baudrimont.—Most authors on this subject have attributed decrepitation to the vaporization of water contained between the laminæ which compose the substance operated upon. This opinion not appearing to me well founded, I dried at a low temperature and by various means, different anhydrous substances capable of decrepitation, but found that notwithstanding the most perfect desiccation, they still decrepitated when suddenly heated. The tendency of the decrepitating body to a separation of its parts in the direction of its cleavage faces, leads me to the following conclusion: that decrepitation is owing principally to the bad conducting power of the several substances, the outer layers expanding by heat, without a corresponding internal expansion, and consequently splitting off with a kind of explosion. There are instances, however, in which the substance is volatile and for this reason decrepitates; but this is not in general the case with decrepitable substances.—*L'Institut, No.* 158.

2. *On Donium, a new substance discovered in Davidsonite;* by Mr. Thomas Richardson.—The mineral Davidsonite was discovered by Dr. Davidson, of Aberdeen, in a marble quarry near that city. An analysis of it by Mr. T. Richardson, proves it to be composed of Silica and a base which Mr. R. supposes to be an oxyd of Donium. This oxyd is distinguished from the alkaline and earthy bases, and from several of the metallic ones, by the green precipitate which it gives with the sulph-hydrate of Ammonia; and its solubility in the caustic alkalies, and in carbonate of Ammonia, the light brown precipitate thrown down by sulphuretted hydrogen, and the green given by sulph-hydrate of ammonia, distinguish it from all the others.

The name Donium is a contraction of Aberdonia, the Latin name of Aberdeen, near which place Davidsonite occurs.—*Rec. of Gen. Sc., June*, 1836.

Since the publication of Mr. Richardson's paper descriptive of Donium, Dr. Bause, of Penzance, has announced that he has been examining for some time a new oxyd which turns out to be identical with that of Donium. We may soon expect a complete account of Donium and its compounds, from Dr. Thomson of Glasgow.—*Ath. No.* 452, *June* 25, 1836.

3. *Solidification of Carbonic Acid;* by M. Thilorier.—M. Thilorier, who had previously succeeded in liquefying this gas, now announces that he has obtained it also in the solid state. Its solidification requires a cold equal to 100°C. below the freezing point, and, although the liquefied gas evaporates almost instantaneously and with the production of a violent explosion, the solid continues some minutes exposed in the open air, and insensibly disappears by a slow evaporation.

A fragment of the solid acid, touched lightly with the finger, slides rapidly over a polished surface, as if it were surrounded by a gaseous atmospere, which appears to be the fact. The evaporation of the solid is complete, leaving however occasionally a little moisture, which is attributable to the action of the atmosphere upon a body so intensely cold.—*Ann. de Chim. et de Ph. T.* 60.

4. *Extraction of Sugar from Indian Corn;* by M. Pallas.—The results obtained by M. Pallas are as follows:

1. The stalk of the corn contains little or no sugar previous to flowering.

2. At the time of flowering, a small quantity of sugar may be detected.

3. When the grain is still soft, about 20 or 25 days after flowering, the plant contains about 1 in 100 of crystallizable sugar.

4. When the grain is completely ripe, the stalk furnishes two parts in 100 of sugar, and 4 in 100 of rich and good-tasting molasses.

The residue remaining after the extraction of the sugar, may be given for food to cattle, or will serve for the manufacture of wrapping paper which will bring 11 francs for 50 kilogrammes.—*L'Institut*, No. 157, 1836.

5. *Reduction of Metals.*—M. Becquerel has succeeded in constructing an Electro-Chemical apparatus by means of Iron, a concentrated solution of common Salt, and an ore of Silver, and thus has been enabled to extract from this ore, the silver it contains, in the form of Crystals. The ores experimented upon were from Columbia and Allemont. The same process may be employed in the extraction of the silver from Copper Pyrites. It is ineffectual only in the case of Argentiferous Galena.—*L'Institut, No.* 147.

GEOLOGY AND MINERALOGY.

1. *Ashmolean Society.*

Copied from the Athenæum, No. 451, London, Saturday, June 18th, 1836, and communicated by Dr. J. Barratt, of Middletown, Conn.

May 20.—The President in the Chair. Dr. Buckland communicated to the Society a notice of some very curious recent discoveries of fossil footsteps of unknown quadrupeds in the new red sandstone of Saxony, and of fossil birds in sandstone of the same formation in the valley of the Connecticut. In the year 1834, similar tracks of at least four species of quadrupeds were discovered in the sandstone quarries of Hesseberg, near Hildburghausen. Some of these appear to be referable to the tortoises, and to a small web footed reptile. No bones of any of the animals that made these footsteps have yet been found. Another discovery of fossil footsteps has still more recently been made by Professor Hitchcock, in the new red sandstone of the valley of the Connecticut. The most remarkable among these footsteps, are those of a gigantic bird, twice the size of an ostrich, whose foot measured fifteen inches in

length, exclusive of a large claw measuring two inches. The most frequent distance of these larger footsteps from one another, is four feet; sometimes they are six feet asunder. p. 436.

Professor Powell afterwards gave a short account of the progress of his researches on light.—*Abridged from the Oxford Herald.*

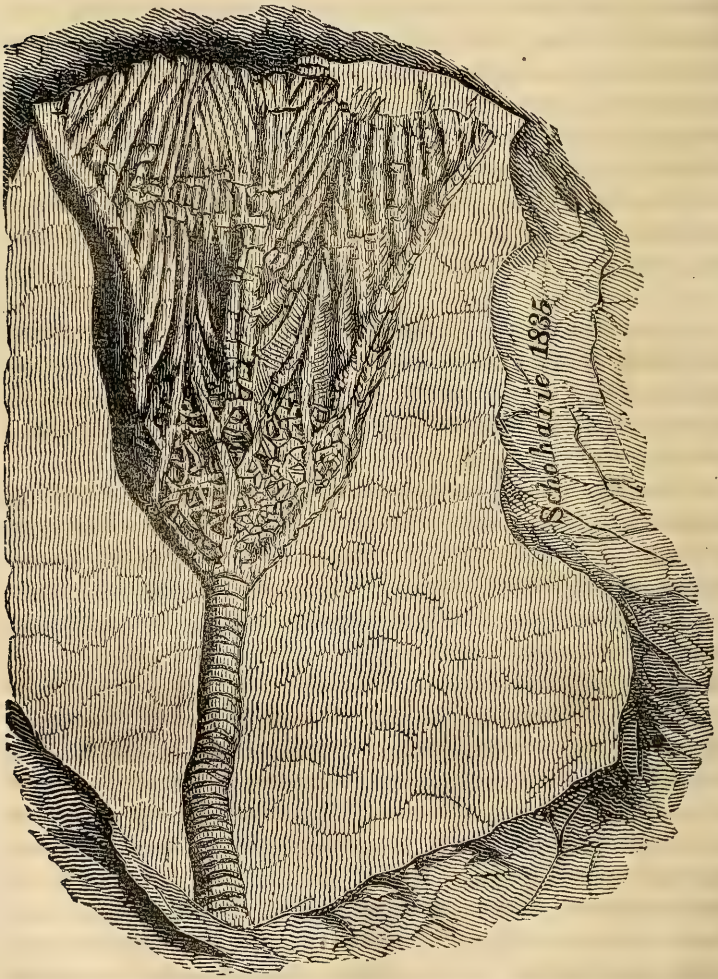
2. *Bird Tracks at Middletown, Conn. in the new red sandstone.*—Extract of a letter to the editor dated Aug. 18, 1836.—I have discovered the tracks of birds similar to those described by Prof. Hitchcock: I have some well marked slabs, with tracks. I find them in a sandstone lying *beneath* the new red fissile sandstone with the vegetable impressions mentioned in a former letter. This sandstone with bird tracks is *perfectly distinct* in character, and differs also from the old red sandstone on which it may rest. I have also found some small fossil ribs in the sandstone, with fossil vegetables on a weather-worn surface—and moreover the leafy extremity of some large fronds in the same sandstone, very fine.

3. *Crinoidea, or Lily Shaped Animals.*—We are indebted to Mr. John Bonny, now of Schenectady, late of Schoharie, N. York, for the loan of a wood cut of a fine crinoideal specimen, and we annex an extract from the notice of it from a Schenectady newspaper transmitted by Mr. D. Tomlinson.

Of the organic beings, for a knowlege of whose existence we are indebted to the researches of naturalists, some of the most interesting are those demominated by Mr. Parkinson, (whose work is quoted by Gen. Dix,) *Encrinites* and *Pentacrinites,* (vulgarly stone lilies, from their resemblance to lilies.) Cuvier arranges them under one *genus,* which he calls "*Encrinus.*"

In the celebrated work of J. S. Miller, A. L. S., we have the best description of Crinoidea, any where to be found. He gives a full and detailed account of all that was known on the subject up to the year 1821, and also the result of his own investigations, which are of the most important nature. His work is illustrated with 50 engravings, containing all the varieties of Crinoidea then discovered. It is singular that among all these, there are none bearing the distinctive character of the one represented in our engraving. It is however referable to *Divisio inarticulata,—genus Antinocrinites,—species polydactylus.* In this division, the plates form the superior cup-like body of the animal, adhering by sutures, lined by muscular

integuments, and enclosing the viscera. The term *actino*-crinitis, is derived from the Greek word "aktinotos," *radiated;* so called because of the radiated markings of the costal and intercostal plates, which are peculiar to this genus. Of the antinocrinites, there are two species; *triacontadactylus*, in which there proceed from five scapulæ 30 fingers, and *polydactylus*, in which there are more than 30 fingers. Divested then of all technical language, our specimen may be termed "*a many fingered, radiated, lily-shaped animal.*"



Any specimens in this department of science, but particularly those unbroken and free from defects, are invaluable to its professors:

and it is rare that any specimen is found more perfect than the one here represented. It is reported that in 1774, the emperor of Germany offered one hundred dollars for "a stone lily free from its matrix, and attached to its column;" and it does not appear that such an one was ever furnished. Mr. John S. Bonny, late of Schoharie, now of this city, who has acquired much celebrity for his mineralogical researches in Schoharie Co., in the spring of 1835, obtained the lily in question. Several days were spent in blasting and breaking rocks, before he discovered it. Mr. B. says he has traced the stems of these lilies the distance of 20 feet. All the other specimens he has been enabled to procure are imperfect, and consist of detached pieces.

Mr. Bonny has furnished us with the following description of their locality.

"It is situated about one quarter of a mile east of the Schoharie court house in a perpendicular ledge of rocks, about 50 feet high. The different strata occur in the following order.

1st stratum, about thirty feet—shell limerock, containing trilobites of the Asaphus variety, the Orthocera, Spirifer and Terebratula of different varieties.

2nd stratum, two feet—in the center of this stratum is a layer of clay slate, one inch thick, in which is found the most perfect Lily; it also contains the stag-horn encrinite, trilobites and terebratula.

3d stratum, eight feet—stratified limerock containing trilobites, species of the echinus, flustra, and orthocera.

4th stratum, ten feet—stratified limerock, containing species of the echinus and flustra.

5th stratum, ten feet—lias contains all the strontianite localities discovered by myself; carbonate and sulphate of strontian, barry strontianite of Traill.

4. *Extracts from an account of a visit to Iceland, by M. Eugene Robert.*—The siliceous concretions formed by the geysers of Iceland, cover an extent of four leagues in length, throughout which there are numerous traces of the ancient geysers. We have hence been enabled to observe this singular formation under all its different forms; passing by insensible shades from that of a loose and friable character, the result of a rapid deposition, to the most compact and transparent. We have not only observed impressions of the leaves of the birch tree, of Equiseta and various grasses, but the trunks of

the birch are in many places distinctly recognizable, presenting much the appearance of ordinary agatized woods. At the present time none of these plants occur on the island, and we may suppose it probable that their destruction was the result of the invasion of the silica.

The numerous thermal springs, in the midst of which the geysers are situated, occupy large vallies in the interior of the island. Appearances indicate that these waters proceed from deep crevices, in which they have been heated by contact with the volcanic fires. The geysers present the most magnificent exhibition during an inundation of the valley by rain. The rivers proceeding from these springs have often the color of milk, owing to the argillaceous bole which they take up in their passage over the siliceous deposits. Such are the white rivers of Olafsai.

Mt. Hecla, like all the heights of Iceland, is entirely covered with snow. No smoke appeared about its summit. Obsidian occurs in rolled masses on its sides, and pumice stone forms a bed thirty feet in thickness near its base. Fragments of the branches of the birch, the remains of the once flourishing forests of the island, are found in the midst of this bed.

After traversing currents of lava of considerable extent, we arrived at the sulphur beds, or solfataras of Krisark. It is literally a mountain of sulphur, and is undergoing continual increase.—*Bulletin de la Soc. Geol. de France. T.* vii. *F.* 1—2. *Paris,* 1835 *à* 1836.

5. *From a memoir on the origin of Mt. Etna, by M. Elie de Beaumont.* (*Ed. New Phil. Jour. Ap.* 1836.)—It has been ascertained that the greater number of the appearances of flames which accompany the volcanic eruptions, are only the effect of the rays of light which emanate from the incandescent lava, and which are reflected by the molecules of vesicular vapor, and of dust disseminated by the eruption in the atmosphere. In consequence of this observation, doubts have been raised as to whether volcanos, in any case, produce real flames. These doubts have been already removed by Sir H. Davy in regard to Vesuvius, where he ascertained, during a small eruption, the existence of a real jet of flame; and we ourselves have observed on Etna incontestible volcanic flames. Having left the *Casa inglese* about an hour and a half before daybreak, in order to ascend to the edge of the crater, the fee-

ble light of the stars enabled us to perceive, on the commencement of the acclivity of the upper cone, a white space whose color was caused by the alteration of the rocks, and by saline efflorescences having a very styptic taste. In the midst of this space, at several points, we distinguished pale and scarcely luminous flames, which seemed to issue from the earth; they occupied the orifices of several irregular openings, which were from one to two yards in width, and were only the enlargements of a tortuous crevice. These flames were evidently produced by a gas disengaged from the crevice, and which did not find the oxygen necessary for its combustion till it reached the external air. The combustion took place almost exactly at the level of the surface of the ground. The flame rarely rose to the height of a yard; it produced a sound somewhat intermittent, pretty analogous to that of several lighted faggots, or rather that which is heard at the bottom of a blast-furnace when the blowing apparatus is badly constructed. The gases produced by the combustion did not impede the breathing, and had a strong odor of sulphurous acid. Sulphuretted hydrogen was also perceptible, but I did not recognize the odor of muriatic acid. Every circumstance, then, announced that the flame was supported by sulphuretted hydrogen, and afterwards, when the sun lighted up the mountain, a long bluish cloud was seen taking its rise from that particular point.

In the interior of the great crater I found several portions of snow, but from many other points of its angular bottom there issued hot vapors, having a whitish color, more or less dense, composed chiefly of watery vapor, but having nevertheless a strong odor of sulphurous and muriatic acids; one or the other of these acids predominated alternately. The surfaces across which the vapors were disengaged were in part covered by saline efflorescences, which were sometimes white, and sometimes colored of an orange-yellow tint by the chloruret of iron, or of a canary-yellow by particles of lava altered by the acid vapors. In some fissures I found white fibrous gypsum, mixed with altered pulverulent yellow lava in which some small nodules of sulphur were disseminated.

The above account of the observations of this distinguished geologist is followed by a statement of his theory of the formation of the mountain. After alluding to the changes of form that have resulted from the frequent production of extensive longitudinal fissures by the earthquakes that accompany or precede an eruption of the

volcano, also to the streams of lava that find their exit through these fissures; to the unequal elevation of their sides by the expanding force below, he draws the conclusion that the foundations of Etna are not immovably fixed, but are undergoing frequent changes. Guided by these considerations, and in addition, observing the extreme slowness with which ejected matter is capable of elevating the central peak, and the improbability, from their structure and situation, that the layers composing the mountain are in the position they were originally accumulated, the author arrives at the following deductions.

The surface formerly nearly flat, has been first repeatedly fractured in various lines having a nearly constant direction. The melted matters have been poured out through the fissures thus produced, and their fluidity must have been nearly perfect, for they have flowed through rents of very inconsiderable breadth. These products were then spread on both sides of the fissures, in thin and uniform masses, similar to those composed of basalt, which in so many different countries, and especially in Iceland, are superimposed above one another, forming vast plateaus whose surface remained always nearly horizontal, in consequence of the subdivision of successive lines of eruption on an extensive space. The eruptions were, like those of the present day, accompanied by disengagements of elastic fluids, which, issuing like the lava itself from the whole extent of the fissures, carried along with them scoriæ and cinders. These scoriæ and cinders falling back like rain, both on the lava and on the neighboring spots, produced those uniform layers of fragmentary substances, which alternate with the layers of melted matters. But at one period, it would appear that the internal agent which had already fractured so frequently the solid surface, having doubtless exerted an extraordinary energy, *broke up that surface, upraised it, and since that time Etna has existed.*

6. *Extract from a letter from* Mr. James Prinsep, *dated Calcutta, Oct.* 25, 1835.—"I am now engaged in making engravings of an antediluvian animal, heretofore unknown, which ranks between the pachydermata and ruminantia, and is provided with four horns. We have christened it *Sivatherium,* in honor of our Indian god Siva."

The fossil skeletons of the above animals were found in the valley of Nerbudda in English India, and form a highly interesting addition to the list of fossil animals.—*L' Institut, No.* 153.

7. *Emmonite, a new mineral species;* by Thomas Thomson, M. D., F. R. S., Prof. Chem. Glasgow.—This mineral was received by Dr. T. from Prof. Emmons, of Williams College, Massachusetts, after whom it is named. The color of the mineral is snow-white; structure obscurely foliated, with imperfect cleavages parallel to the lateral faces of a Right Rhombic Prism. An approxmate measurement on cleavage faces gave 113° for the obtuser angle of the prism. Fracture in the direction of the cleavage planes, flat and smooth; but the mineral in general had a scaly appearance, not unlike some varieties of gypsum, translucent on the edges, very easily reducible to a powder. Hardness, 2.75; specific gravity, 2.9463.

The analysis of Dr. T. gives for its composition

Carbonate of Strontian, - - -	82.69
Carbonate of Lime, - - -	12.50
Peroxyd of Iron, - - - - -	1.00
Zeolite, - - - - - -	3.79
	99.98

and consequently it consists, neglecting the two latter ingredients, of two atoms Carbonate of Lime, and nine Carbonate of Strontian.

8. *Retrospective Notice of the discovery of fossil Mastodon Bones in Orange County, (N. Y.)*

(From a letter, addressed by Sylvanus Miller, Esq., to Hon. Dewitt Clinton, in 1815.)

The first discovery of these bones was made about 1785, in the town of Montgomery, in Orange County. In digging a ditch in a miry meadow, to carry off the excess of water, several ribs and teeth and a thigh bone, were discovered; the ribs and teeth were very sound. Remains of several skeletons were afterwards discovered, and Mr. Peale, of Philadelphia, by great pains and expense, succeeded in obtaining bones sufficient to construct two skeletons. Mr. Miller contributed in an important degree to the success of these undertakings.

The only places where these fossils were found in this neighborhood, were in the towns of Montgomery and Shawangunk; the former in Orange, and the latter in Ulster county, about 80 miles from New York, and from 6 to 12 from Newburgh on the Hudson river. In low situations, the receptacles of vegetable and testaceous solutions, the bones of the mastodon have been (at least as regards this

region) uniformly found. In many places the marl is 30 feet deep, and over it grass and plants, and even trees, grew in abundance. In these places are uniformly found living springs, and abundance of snails and muscles, which, with vegetable substances, constitute the marl of different colors and qualities. Within the sweep of a radius of six miles, there are several hundred acres of marl, at the bottom of which the bones have been uniformly found. Within this area nine skeletons of the mastodon have been found, and yet not one hundredth part of the area has been explored to the bottom: it is probable therefore that vast numbers remain undiscovered, and that at some period this district was fully inhabited by these stupendous animals.

The discovery of the bones in a particular kind of earth, affords reasonable inferences as to the nature of the animal; while the quantities of marl and other productions, furnish also interesting calculations in chronology. Covered originally by sheets of water, and abounding in aquatic plants, and shell and other fishes, as well as amphibious animals, it is probable they afforded a rich repast for the mastodon, thus tempting him into treacherous quagmires, where he found his death, probably by miring, as happens with cattle at the present day.* With these relics of the mastodon were found locks and tufts of hair, in tolerable preservation: its color was of a dun brown; length from 1½ to 2½ inches, and in one instance it was from 4 to 7 inches long, of the same color as the shorter, and was supposed to be the mane of the animal.

9. *Analysis of North American Minerals, by Dr. Thomson.*

1. Holmesite.—This is the mineral found, with Hornblende, Pyroxene and Spinel, in white limestone, at Amity, N.Y., and generally recognized as Bronzite, but which Mr. Clemson has analyzed and described as Seybertite.† Its sp. gr. is 3.098.

* We have been informed by Mr. Miller in conversation, that most of the skeletons were found with the head and neck bent backward, doubling upon the body, as happens to modern animals when, in like circumstances, they give over to die.

† See this Journal, vol. xxiv. p. 171. Mr. Clemson obtained the following result.

Water, - - - - -	0.036
Silica, - - - - -	0.170
Alumina, - - - - -	0.376
Magnesia, - - - - -	0.243
Lime, - - - - -	0.107
Protox. iron, - - - -	0.050

		Atoms.
Silica,	19.35	9.68
Alumina,	44.75	19.88
Zirconia,	2.05	0.54
Perox. iron,	4.80	0.96
Ox. manganese,	1.35	0.30
Lime,	11.45	3.27
Magnesia,	9.05	3.62
Water,	4.55	4.04
Fluoric acid,	0.90	0.72

Supposing the fluoric acid to be united with lime, and to constitute fluor spar, the constitution of the mineral is thus expressed:

$$11\text{Al}\,3\text{S}+\left\{\begin{matrix}\text{Zir.}\\ f\\ \text{Mn}\end{matrix}\right\}3\text{S}+1\tfrac{1}{2}\text{Cal}\,3\text{S}+2\text{Mag}\,3\text{S}+2\text{Aq}$$

The mineral is designated in honor of Dr. Holmes, Prof. of Chemistry in the McGill College of Montreal.

2. *Compact Feldspar, from Bytown, Lower Canada.* Sp. gr. 2.8617.

Silica,	45.80
Alumina,	26.15
Perox. iron,	4.70
Lime,	16.25
Magnesia,	2.95
Water,	2.00
	97.85

Its formula is $2\text{Al}\,\text{S}+\left\{\begin{matrix}\text{Cal}\\ \text{Mg}\\ f\end{matrix}\right\}\text{S}^2$

According to Dr. Thomson, it is identical with Amphodelite, which he considers a variety of Scapolite. The formula of Scapolite is $2\text{Al}\,\text{S}+\text{Cal}\,\text{S}$.

3. *Deweylite?** Sp. gr. 2.0964.

Silica,	50.70
Magnesia,	23.65
Water,	20.60
Alumina,	3.55
Protox. iron,	1.70

* The locality of this mineral is not known.

Admitting 0.11 atoms of magnesia, and 0.04 atoms of protox. iron, to be in combination with alumina, and only accidental, and 0.16 of water, to be mechanically lodged in the mineral, then it will be a bihydrous tersilicate of magnesia; and is therefore the magnesite of Dr. Thomson's Mineralogy, Vol. I. p. 178.

Another mineral was sent to Dr. Thomson, under the name of Deweylite, by Dr. Holmes, concerning whose locality nothing is recollected, and which consists of

Silica,	41.42
Magnesia,	23.53
Soda,	6.25
Alumina,	4.47
Oxide of cerium,	3.57
Protox. of iron,	a trace.
Water,	19.86

It is a triple, if not a quadruple salt.

10. *Ornithichnites in Connecticut.*—Extract of a letter from *Prof. E. Hitchcock*, dated June 28th, 1836.—In my account of the Ornithichnites in New Red Standstone, given in the last January number of the Journal, I intimated that perhaps they might be found at a place called the Cove, in Wethersfield, Ct. I went to Hartford last year mostly to visit this spot; but having been there informed that no rocks existed at the Cove, I did not go there. Yet recently a young gentleman of the Junior Class in Amherst College, whose father resides near the spot, and who had carefully examined my specimens of Ornithichnites, informs me that he has discovered them at the Cove in considerable abundance and variety. But I will give you an account of them in his own words.

"The first specimen I examined was a step stone which had been in use nearly a century; on which were four steps, whose length was 14 or 15 inches, and the length of the foot 4 or 5 inches. The middle toe has three tuberous swellings, the outer ones two. The claws are all of considerable length. This resembles your *O. tuberosus*, *α dubius*. Upon another door step in the same vicinity, I found two rows of tracks, the feet having the same direction. The length of these steps is 29 inches, and of the foot 7 inches, swellings and claws on the toes.

At the Rocky Hill quarry, in Hartford, I found a specimen closely resembling that just described: the length of the foot 6 or 7 inches, and of the step 27 inches—I found there but two tracks.

Some at Wethersfield have the impression of a hairy appendage at the heel. These have the middle toe much longer, in proportion to the rest, than any that I found. Length of the foot without the appendage, between 3½ and 4 inches.

I saw one track of what appears to be *O. tetradactylus;* the hind toe being turned inward, and its extremity more deeply impressed than usual. Length of the foot, 3 inches.

I have but one other class to describe. The toes vary in length from three fourths of an inch to two inches, and were more divergent than usual. It appears to be *O. minimus.*

One specimen of *O. tuberosus* has the toes and claws bent under, as if the bird were in the act of seizing or raising something.

On one fragment of the rock, I found the ends of two toes with nails, which seemed to be about two thirds the size of your *O. giganteus.*

I think I have seen the impression of toe nails as distinctly upon the slender toed species, as upon the other species."

Mr. Hanmer also describes vegetable remains of considerable size upon the same rock; and from his account, I suspect them to belong to the tribe of Fucoides.

I hope that you, or the gentlemen engaged in a geological survey of the State, will be able to visit this spot, to see whether any discoveries can be made, or to make any corrections of the above statement, that may be found necessary.

11. *Delos—Greece—titanium—iron, &c.*—Extracts of letters to the editor, from the Rev. J. J. Robertson, Episcopal Missionary to Greece, at Syra and the Piræus, Nov. and Dec. 1835.—My chief relaxation during the past summer, was a two days' visit to Delos, in company with Lt. Stanley, who was employed for several weeks by the government, in forming a map and chart of our little island. I brought from Mount Cynthus a specimen of the granite of which Delos is, in a great measure, composed, and in which I discovered small yellow crystals of the silico-calcar-oxide of titanium (sphene.) Some time after, examining a fragment of granite which I procured three years since from a column among the ruins of the so called temple of Diana at Ephesus, I found it to contain perfectly similar crystals.

The director of mines for the kingdom of Greece, was at Syra a few months since, and I took one or two excursions with him. We

discovered on the side of a hill, between the upper and lower towns, an iron mine which had been formerly wrought, and thought it still deserving of attention. The excavation was carried horizontally into the side of the hill, and is now used by shepherds to pen their flocks, and is called the black sheep fold. A little in front of its entrance, stands a large mass of the ore, eight or ten feet high. I remarked that the mine had probably been wrought by the Venetians, towards the end of the period when they had possession of the island, and that this would account for the work having been interrupted. The director replied, that the Venetians would have made use of gunpowder,—but as it is evident that the ore has been hewn out, and not blasted, it must have been the work of the ancient Greeks.

The same gentleman also discovered the red oxide of titanium, or rutile, which seems not to be very rare in our part of the island. There is also manganese sufficient for some useful purposes. Iron abounds at Cape Sunium and coal in Negropont (Eubœa.) The director showed me hæmatite from Andros—serpentine from Tenos in masses large enough to be wrought into urns, &c. He told me of sulphate of barytes, extending across parts of the island of Mycone like white walls.

We are on board the steam boat Levant at the Piræus. It brings strange associations, to be on board a steamer in sight of the Parthenon, and with the ruins of the long wall of Themistocles running along one side of the harbor! About twenty-five dwellings and warehouses have been erected at the Piræus, but all things move slowly in Greece. The country is exceedingly poor, and its few resources have scarcely begun to be developed.

12. *Remarks on the lavas, &c. of Mexico and South America, in a letter to the editor, dated January* 24, 1836.—The lavas are of all varieties, from the most sound basalt to the most porous pumice. I have been reflecting upon some of the most probable causes of the absence of crystallization in the lavas of this country. The Andes contain a much greater volume of volcanic rocks than any thing in Europe, and probably the force of heat necessary to liquefy such an enormous mass, might have been so great as to melt all the crystals that might have been in the primitive or other rocks, which, in smaller and less heated eruptions, were thrown out as crystals. In all lavas, when the vacancies are filled, it is

done by infiltration, and the results most probably depend on the nature of the water—that is, upon what the water contains dissolved, &c.

MISCELLANEOUS INTELLIGENCE.

1. *Plumbago and Black Lead pencils.*—There is only one purpose to which this form of carbon is applied in the solid state, viz., for the manufacture of black lead pencils, and its adaptation to this end depends upon its softness. In the state of a powder, plumbago is used to relieve friction. Its power in this way may be illustrated by rubbing a button first on a plain board, five or six times, and applying it to a bit of phosphorus, the latter will immediately burn. When rubbed on a surface covered with plumbago, double or triple the friction will be required to produce the same effect. One of the most remarkable circumstances connected with the plumbago is the mode in which it is sold. Once a year the mine at Borrowdale is opened, and a sufficient quantity of plumbago is extracted, to supply the market during the ensuing year. It is then closed up, and the product is carried in small fragments of about three and four inches long, to London, where it is exposed to sale, at the black lead market, which is held on the first Monday of every month, at a public house in Essex street, Strand. The buyers, who amount to about seven or eight, examine every piece with a sharp instrument to ascertain its hardness—those which are too soft being rejected. The individual who has the first choice pays 45*s.* per pound; the others 30*s.* But as there is no addition made to the first quantity in the market, during the course of the year, the residual portions are examined over and over again, until they are exhausted. The annual amount of sale is about £3000. There are three kinds of pencils, common, ever-pointed, and plummets. The latter are composed of one-third sulphuret of antimony and two-thirds plumbago.

The 1st part of the process is sawing out the cedar into long planks, and then into what are technically called tops and bottoms. The 2d, sawing out the grooves by means of a fly-wheel. The 3d, scraping the lead on a stone; having been previously made into thin slices, to suit the groove; introducing it into the groove, and scratching the side with a sharp pointed instrument, so as to break it off exactly above the groove. The 4th, glueing the tops and bottoms together, and turning the cedar cases in a gauge.

The *ever-pointed* pencils are first cut into thin slabs, then into square pieces, by means of a steel guage. They are then passed through three small holes, armed with rubies, which last about three or four days. Steel does not last above as many hours. Six of these ever-pointed pencils may be had for 2*s*. 6*d*. If they are cheaper than this, we may be sure that they are adulterated.

In Paris, when you buy a sheet of paper in a stationer's shop, some of these pencils are added to the purchase. Now these are formed of a mixture of plumbago, fuller's earth, and vermicelli. Genuine cedar pencils must cost 6*d*. each. If they are sold at a lower price, they must be formed from a mixture, not from pure plumbago. Pencils are, however, sold as low as 4½*d*. a dozen.—*Rec. of Gen. Sc. June,* 1836.

2. *A comparative and chronological table of the largest Libraries in the world.*

	Founded in	Contains vols.	Manuscripts.
Paris: Royal Library, -	1595	626,000	80,000
Munich: Royal Lib. -	1595	540,000	16,000
St. Petersburg: Imperial Lib.	1728	432,000	15,000 ?
Copenhagen: Royal Lib. -	1648	410,000	16,000 ?
Vienna: Imperial Lib. -	1440	284,000	16,000
Berlin: Royal Lib. -	1661	280,000	5,000
Pekin: Imperial Lib. -		280,000	
Dresden: Royal Lib. -	1556	260,000	2,700
Gottingen: University Lib.	1736	250,000	5,000
London: Lib. of the Brit. Museum,	1759	220,000	22,000
Oxford: Bodleian Lib. -	1480	200,000	25,000
Wolfenbuttel: Ducal Lib. -	1604	200,000 ?	4,500
Madrid: Royal Lib. -	1712	200,000	2,500 ?
Paris: Lib. at the Arsenal,		186,000	5,000
Stuttgart: Royal Lib. -	1765	174,000	1,800
Milan: Brera Lib. -	1763	169,000	1,000
Naples: L. of the Bourbon Mus'm,		165,000	3,000
Florence: Magliabecchian Lib.	1714	150,000	12,000
Breslau: University Lib. -		150,000	2,300
Munich: University Lib. -	1595	150,000	2,000 ?
Edinburgh: - -	1682	150,000	6,000
Jedo: Lib. of the Sjogoun, -		150,000 ?	
Miako: Lib. of Mikado, -		150,000 ?	

Bib. Univ. Geneva, Oct. 1835.

3. *The Travellers.*—Letters have been received from Mr. Nuttall, the botanist, and his companion, John K. Townsend, of Philadelphia, dated in September of last year, from Fort Vancouver, Columbia River. They were in good health, and would set out soon for home, either via Santa Fe or England, and may be at home in the fall of this year. Last week the Academy of Natural Sciences of Philadelphia received safely from them *via* Cape Horn many large boxes;—among Mr. Townsend's collection alone are three hundred birds and fifty quadrupeds, many of which are unknown to naturalists. We eagerly await the return of these gentlemen, in order that their remarkable scientific acquisitions, together with the eventful personal narrative of the travellers, may be given to the public.—*Waldie's Circ. Library, July* 12, 1836.

4. *Report on introducing Pure Water into the city of Boston*; by *Loammi Baldwin*, Esq. Civ. Eng. 2d ed. 340 pp. 8vo. Boston, 1835.—It is but poor economy to forego any expense necessary for the introduction of water into every part of a large city. Not only comfort and health depend to a great degree on its purity and abundance, but it is the only security against the ravages of fire, and the great preventive, by the promotion of cleanliness, of the epidemics to which all large cities are subject. Such benefits are worth many times the $750,000 which it is calculated will be required to supply the city of Boston with water. The Report contains general accounts of the water works in other countries, besides more particularly a statement of the best means of supplying Boston. It is accompanied with several plans and profiles. The whole work is one of much general interest, and does much credit to its distinguished author. The volume is closed by an important article of 30 pages on Springs, Artesian Wells, &c. by M. Arago, first published in the Annuaire du Bureau des Longitudes, pour 1835.

5. *Transactions of the Albany Institute*, Vol. II. part 2, 50 pp. 8vo. Albany, 1836.—We have before us, in this continuation of Vol. II. of the transactions of this society, the annual address delivered before the Institute, April, 1836, by Daniel P. Barnard, and also the report of the committee appointed to take Meteorological observations on the 21st of June, September, December and March, agreeably to the plan proposed in 1834, by Sir John Herschel. This report is accompanied by a lithographic chart exhibiting the

comparative variations of the Barometer at Montreal, Albany, Flushing, L. I., Middletown, Conn., and Cincinnati, Ohio.

6. *On the Application of the Hot Blast, in the Manufacture of Cast-Iron,* by Thomas Clark, M. D., &c. (Trans. Royal Soc. Edin. xiii.)—The substitution of hot for cold air, in the blast furnaces of the iron manufactory, is an improvement which suggested itself to the ingenious Mr. Neilson, of Glasgow, at a most seasonable period; when the great demand for iron in the construction of railways is daily, nay, hourly, increasing.

The original process consisted in introducing a charge of coke, limestone, and *mine*, or burned iron stone, into the top of the iron furnace; and this mixture was excited to combustion by air forcibly driven in, at about forty feet from the top, through pipes from a blowing apparatus. The iron was thus separated from carbonic acid, alumina, and silica; and was allowed to run off at the bottom.

Mr. Neilson improved this process, by substituting for air at the temperature of the atmosphere, air heated up to 300° and upwards. This is effected by passing the air through the cast-iron pipes, through which the former passed, kept in a red heat.

During the first six months of the year 1829, when all the cast-iron in Clyde iron-works, was made by means of the cold blast, a single ton of cast-iron required for fuel to reduce it, 8 tons 1¼ cwt. of coal converted into coke. During the first six months of the following year, while the air was heated to near 300° Fahr.: one ton of cast-iron, required 5 tons 3¼ cwt. of coal, converted into coke.

The saving amounts to 2 tons 18 cwt. on the making of one ton of cast-iron; but from that saving comes to be deducted the coals used in heating the air, which were nearly eight cwt. The nett saving thus was 2½ tons of coal on a single ton of cast-iron. But during that year, 1830, the air was heated no higher than 300° Fahr. The great success, however, of these trials, encouraged Mr. Dunlop, and other iron masters, to try the effect of a still higher temperature. Nor were their expectations disappointed. The saving of coal was greatly increased, insomuch that about the beginning of 1831, Mr. Dixon, proprietor of Calder iron-works, felt himself encouraged to attempt the substitution of raw coal for the coke before in use. Proceeding on the ascertained advantages of the hot blast, the attempt was entirely successful: and since that period, the use of raw coal has extended so far as to be adopted in the majority of the Scotch

iron-works. The temperature of the air under blast, had now been raised so as to melt lead, and sometimes zinc, and therefore was above 600° Fahr., instead of being 300° as in the year 1830.

"During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast-iron was made by means of 2 tons 5¼ cwt. of coal, which had not previously been converted into coke. Adding to this eight cwt. for heating, and we have 2 tons 13¼ cwt. of coal required to make a ton of iron; whereas, in 1829, when the cold blast was in operation, 8 tons 1¼ cwt. of coal had to be used. This being almost exactly three times as much, we have from the change of the cold blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splint coal.*

"During the three successive periods that have been specified, the same blowing apparatus was in use; and not the least remarkable effect of Mr. Neilson's invention, has been the increased efficacy of a given quantity of air in the production of iron. The furnaces at Clyde iron-works, which were at first three, have been increased to four; and the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named, and the successive weekly consumpt of fuel put into the furnace, apart from what was used in heating the blast:

	Tons.		Tons.		Tons.	
In 1829, from 3 furnaces,	111	Iron from	403	Coke, from	888	Coal.
In 1830, from 3 furnaces,	162	Iron from	376	Coke, from	836	Coal.
In 1833, from 4 furnaces,	245	Iron		from	554	Coal.

"Comparing the product of 1829, with the product of 1833, it will be observed that the blast, in consequence of being heated, has reduced more than double the quantitity of iron. The fuel consumed in these two periods we cannot compare, since in the former, coke was burned, and in the latter coal. But on comparing the consumpt of coke in the years 1829 and 1830, we find that although the product of iron in the latter period was increased, yet the consumpt of coke was rather diminished. Hence the increased efficacy of the blast appears to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron."

The temperature was so high, that it was found necessary, in order to prevent the melting of the cast-iron lining near the nozzles of the blowpipes, to substitute for the solid lining a hollow one, filled with water, which is continually changing as it becomes heated.

Dr. Clark gives what we conceive to be the obvious explanation of the mode in which the hot air acts.—Berthier, it is true, has broached another.—(See "Records," ii. 151.) But it is far-fetched, and superseded by the more simple explanation presented by our author. He observes:

"As nearly as may be, a furnace, as wrought at Clyde iron-works in 1833, had two tons of solid materials an hour put in at the top, and this supply of two tons an hour was continued for 23 hours a day, one half hour every morning, and another every evening, being consumed in letting off the iron made. But the gaseous material, the hot air—what might be the weight of it? This can easily be ascertained thus: I find by comparing the quantities of air consumed at Clyde iron-works, and at Calder iron-works, that one furnace requires of hot air from 2500 to 3000 cubical feet in a minute. I shall here assume 2867 cubical feet to be the quantitity; a number that I adopt for the sake of simplicity, inasmuch as, calculated at an avoirdupois ounce and a quarter, which is the weight of a cubical foot of air at 50° Fahrenheit, these feet correspond precisely with 2 cwt. of air a minute, or *six tons an hour*. Two tons of solid material an hour, put in at the top of the furnace, can scarce hurtfully affect the temperature of the furnace, at least in the hottest part of it, which must be far down, and where the iron, besides being reduced to the state of metal, is melted and the slag too produced. When the fuel put in at the top is coal, I have no doubt that, before it comes to this far-down part of the furnace, the place of its useful activity, the coal has been entirely coked; so that, in regard to the fuel, the new process differs from the old much more in appearance than in essence and reality. But if two tons of solid material an hour, put in at the top, are not likely to affect the temperature of the hottest part of the furnace, can we say the same of six tons of air an hour, forced in at the bottom near that hottest part? The air supplied is intended, no doubt, and answers to support the combustion; but this beneficial effect is, in the case of the cold blast, incidentally counteracted by the cooling power of six tons of air an hour, or two cwt. a minute, which when forced in at the ordinary temperature of the air, cannot be conceived otherwise than a prodigious refrigeratory passing through the hottest part of the furnace, and repressing its temperature. The expedient of previously heating the blast, obviously removes this refrigeratory, leaving the air to act in promoting combustion, without robbing the combustion of any portion of the heat it produces."

From a table appended to this paper, and furnished by Colin Dunlop, Esq., it appears that in 1829, the average weekly product of the Clyde iron-works was 110 tons, 14 cwt. 2 qrs., and the average of coals used to 1 ton of cast iron was 8 tons, 1 cwt. 1 qr. with the cold air; while in 1830, these numbers were respectively, 162 tons, 2 cwt., 1 qr., and 5 tons, 5 cwt. 1 qr. with heated air; and in 1833, 245 tons, and 2 tons, 5 cwt. 1 qr., also heated air. The following table gives the materials constituting the charge in the several years.

Materials constituting a Charge:

		cwt.	qrs.	lb.
1829,	Coke, . .	5	0	0
	Roasted Ironstone,	3	1	14
	Limestone, .	0	3	16
1830,	Coke, . .	5	0	0
	Roasted Ironstone,	5	0	0
	Limestone, .	1	1	16
1833,	Coal, . .	5	0	0
	Roasted Ironstone,	5	0	0
	Limestone, .	1	0	0

Rec. of Gen. Sc. June, 1836.

7. *Climate of Palestine.*—In the Annuaire of 1834, M. Arago published a memoir, which had for its object to prove, that since the time of Moses, the temperature of Palestine has undergone no sensible alteration. The duke of Ragusa denies the accuracy of the facts on which the conclusion is founded. He says, "there are no palms in the part of Palestine indicated by the memoir." But, nevertheless, I find farther on in the Marshal's communication, "that there are a few at Jericho;" that at Jerusalem, he saw three "nearly barren;" at Rama, a place cited in the article in question, "there are some which yielded fruit:" but certainly if there are some at that spot, a great many might exist. One single palm-tree producing ripe fruit, would be sufficient in a question as to the temperature. The limit assigned, in the same article of the Annuaire, to the cultivation of the vine, is also called in question. We here transcribe this portion of the memoir, in order that botanists themselves may decide if the facts adduced by the duke of Ragusa, are of a nature to modify their old opinions. "The article fixes at be-

tween 21° and 22° cent. (69°.8 and 71°.6 Fah.) the maximum of temperature that the vine can bear when productive, and to justify this assertion, it states, that at Cairo, where the mean temperature is 71°.6 Fah., the vine is not cultivated on the great scale, and that there are there only detached vine plants. This is the fact in regard to the past, but then the cause is quite of another description. Considerable plantations of vines have lately been made, which promise to afford excellent returns; but a decisive fact is that there have always been and still are, vines in Fayoum, which is one of the hottest provinces in Egypt, owing to the hills of sand which surround it on all sides. These vines are situated at the villages of Fidemia, Adjamira, and Tumban; they are cultivated by the Cophts, and yield agreeable wines. That which I have drunk presents a phenomenon which is rare in such a climate; it does not affect the head, and is drinkable after the second year. Pococke, who traveled in 1737, speaks of the cultivation of the vine by the Cophts in Fayoum, and what is still more important, there is in the higher parts of Upper Egypt, at Esné, twelve leagues to the south of Thebes, a vineyard which has an extent of several feddams. Its original object was to yield grapes for eating, but Jussuff Kiacheff, formerly soldier in the army sent to Egypt, and who was taken prisoner by the Mamelukes at the period of the evacuation, and remained in the east, informed me that he farmed the vineyard; that he made excellent wine of the produce, and obtained a quantity equal to that afforded by the vineyards of Europe. We may then conclude from these facts, that if in Egypt, till within a few years, the vine has not been cultivated on a great scale, it is because the inhabitants do not drink wine, and that we are not to draw the inference, that there is a maximum of temperature above which the vine does not yield the means of making wine."—*Edin. New Philo. Jour. April*, 1836.

8. *The Mathematical Miscellany*, conducted by C. Gill, Professor of Mathematics in the Institute at Flushing, Long Island, New York.—We notice with great pleasure, the receipt of the first number of this unassuming periodical, and we cordially recommend it to our young friends, as one of the best means of drawing out the mathematical talent of the country. Works of this kind have always been beneficial in their influences; and when conducted with a proper spirit, and good judgment, have been quite efficient in fostering emulation, and in promoting the circulation of science. The very

danger to which they are most exposed, and of which we have lately had some unpleasant instances, that of becoming the arena of unfortunate disputes, is a strong proof of the interest which they excite. From all such dangers we trust that the "Miscellany," will be preserved by the energetic management of its enlightened editor; and our confidence in his abilities, is not a little strengthened by the perusal of the excellent dissertations which accompany the present number. The "Illustrations of Lagrange," are highly to be commended to the student, who is just beginning to apply the formulas of the most profound and accomplished of all mathematicians. The treatise on Spherical Geometry, is a lucid and an almost entirely original dissertation on the method of applying algebra to the surface of the sphere, in the same way as it is applied to the plane. The advantages are the same in both cases; and the mathematician is equally well enabled to give an algebraic dress to any enquiry, without perplexing his mind with geometrical considerations. But the chief source of interest will probably be found in the questions which are proposed to be solved in the succeeding number; and, after a careful examination of them, we feel authorized in recommending them as skillfully selected, with a proper regard to variety and difficulty, and we add as the result of our experience, that a better acquaintance with any mathematical subject, may be derived from the solution of a single problem, than from reading a volume upon it, and it is only by the continual solution of problems, that the use of mathematical tools can be acquired, and the inventive powers be matured. We are too prone to consider the mere reader of mathematics as a mathematician, whereas he does not much more deserve the name, than the reader of poetry deserves that of poet. There are indeed exceptions to this remark, and there are works which none but a bona fide mathematician could read. Thus Laplace did little more than give the results of his calculations to the world; so that the thorough reading of the Mecanique Celeste, in the original, involves the frequent solution of the most difficult problems, and none but a mathematician of the highest genius, could have achieved the finished translation with the splendid commentary upon it, which only our country has been able to produce.

9. *Boston Journal of Natural History.*—The 3d No. of Part I. of this important publication has recently appeared. A large part of the number is occupied by the first portion of a paper of the late

distinguished entomologist, THOMAS SAY, containing descriptions of new species of North American Hymenoptera, and observations on some already described. The article is evidently the result of long continued labor, and is a most valuable contribution to science. The second article is a sketch of the geology of Portland and its vicinity, by Prof. EDWARD HITCHCOCK, whose character is a sufficient warrant for the value of his papers. It is accompanied by a map. Next follows an examination of Smith's catalogue of the marine and fresh water fishes of Massachusetts, by D. H. STORER, M. D. The last article is a chemical analysis of three varieties of bituminous coal and one of anthracite, by C. T. JACKSON, M. D.

10. *On the establishment of Statistical Societies in the United States.*—To PROF. SILLIMAN.—The Statistical Society in Paris have selected me as their representative in the United States, for the purpose of transmitting to them any documents which I might be enabled to procure, and for generally aiding their very useful endeavors in Paris, I respectfully desire to propose for consideration the establishment of a "General Statistical Society" in the United States, and to give general publicity to this I have selected your widely circulated Journal as the organ of communication.

The Statistical Society of France was established by Monsieur Cæsar Moreau in 1829; by the high talent of this gentleman, his extensive and varied information, joined with his activity and industry, this society has now the united assistance of almost every government in Europe. The immediate object of the Society rests upon the fact, That the knowledge of mankind increases in proportion to its tendency to observe, and that Statistical Tables, connected with general and particular information, tend greatly to facilitate this development.

To gather and condense facts which tend to show the increase or decrease of Population, the prosperity of Arts and Manufactures, the state of public instruction, to develop the true state of Agriculture, and generally to make known the exact internal state of a great nation, its imports and exports, the state of its national funds, and those of Chartered companies, must ever claim the attention of every enlightened community. In aiding the deliberations of Government, I deem it of the highest importance, and I am enabled to state that the European Governments have already experienced great advantages from the labors of Statistical Societies, and from

that of France in particular. They have tended to facilitate the views of the Statesman, by offering to him in a condensed form, the internal sources of wealth, not only of his own, but of surrounding nations; their labors render the public happiness more secure, inasmuch as the dark paths of the future may become enlightened by the experience of the past; they offer a solid basis for political and social economy, and they relieve and assist the Ministry of a Government by condensing and bringing to a focus, not only the minutiæ, but deduced facts relative to the internal or external power of any nation, either remote or in their immediate vicinity.

In the United States of America, however, the existence of such Societies must be of incalculable benefit. The embryo gigantic powers of this Republic are now beginning to develop themselves, and it is of primary importance that the grand stream of prosperity be directed into that course which will not only secure the present prosperity, but also the future greatness of the United States, whilst it must add to the welfare and happiness of her population.

The present popular system of rapid and cheap communication, has already been anticipated by the enterprising genius of the United States, and she forms a very prominent example of the immense advantages which a nation derives from the projection of such plans as shall tend to give full scope to the energies of the people, whilst at the same time it opens the paths to the development of her internal resources, commercial, mineral or agricultural.

To mark out and prudently to direct the course of such facilities of communication, requires the aid of statistic information. The fecundity of the soil, the amount of population, the manufactured products and their separate values, each require particular consideration; and this can be obtained only by personal research. The condensation of such researches forms one of the leading features of a Statistical Society. To accumulate and condense the information given by modern authors, and more particularly that offered by persons who have occasion to visit foreign countries for scientific research, forms the object of the "Universal Statistical Society of France." To contrast the present degree of prosperity with the past, and to enquire into the causes of the increase or diminution, is its particular care; to trace the gradual development of the causes which have influenced the progress, increase, and present actual state of the wealth and power of civilized nations, forms the grand utility to society produced by their united labors; and finally,

to contract into one general focus the energies of each nation, and comparing the state of their society both moral and political, their commerce, internal and external, and their state of Literature and the Fine Arts, with that of another Empire, demands for it the title of "Universal," and eminently merits the zealous support of every enlightened individual, whose nobility of mind prompts him to offer his mite to the general stock of knowledge.

Should this communication through your Journal be the means of having formed in your principal cities, establishments of a statistical nature, be assured that each Society will receive every aid and assistance from the "Universal Statistical Society of France," which will ever be anxious to advance their researches, and to act with them reciprocally. I have the honor to remain,

Your very obedient serv't,

CHARLES SANDERSON,

Mem. of the U. S. S. of France, the Imp. Agri. Soc. of Vienna, &c. &c.

New York, Dec. 10, 1835.

11. *Tobacco, a remedy for Arsenic*; communicated to the Editor by Rev. RALPH EMERSON.—About the year 1820, Miss Sophia Eastman of Holles, N. H. (now connected with the orphan asylum in Troy, N. Y.) fell into the mistake, so often committed, of eating a portion of arsenic which had been prepared for the destruction of rats. Painful symptoms soon led to inquiry; and her mistake was discovered. An elderly lady who was present, advised that she should be made to vomit as speedily as possible, and as she had always felt a perfect loathing for tobacco in every shape, it was supposed that this would at once effect the purpose. A pipe was used, but without producing any nausea. She next chewed a large portion of strong tobacco, and swallowed the juice, and that without even a sensation of disgust. A strong decoction was then made with hot water, of which she drank perhaps half a pint. Still there was neither nausea or dizziness, nor did it operate at all either as an *emetic* or a *cathartic*. The painful sensations at her stomach, however, subsided, and she began to feel well. On the arrival of physicians, an emetic of blue vitriol was administered, which operated moderately once. One or two days after, there was a discharge of a dark green color, approaching to black. No ill consequences followed.

Another case occurred in the same place, a few years subsequent, in which arsenic was taken through mistake, by a sick person, and she employed tobacco with the like success. She, too, had always loathed the article, but now chewed it and swallowed the saliva, without producing sickness at the stomach. No emetic was administered in this case, nor any other remedy. Happy will it be for our race, should this insidious poison, now the slow death of so many, be employed only as an antagonist to those other deadly poisons, for which it may have been provided by the Creator, as a sure and speedy remedy.

The above facts I lately received from Dr. Eastman, of Holles, the father of Sophia, and from her sister, at whose house Sophia committed the mistake. Yours truly,

RALPH EMERSON.

Andover, Mass. May 26, 1836.

12. *Shower of Falling stars in Russia, on the night between the 12th and 13th November*, 1832.—The following extract of a letter from Monsieur le Comte de Suchteln, to Monsieur Feodorou, was communicated to the "Royal Academy of Sciences" at Paris, in which mention is made of numerous meteors which were seen in the neighborhood of Orenburg, in the night between the 12th and 13th November, 1832. "In the night between the 12th and 13th November, 1832, between three and four in the morning, the weather being calm and serene, and the thermometer being at 55° of Fahr. the heavens appeared to be bespangled by a great number of meteors, which described a great arch in the direction of from north-east to south-west. They burst like rockets, into innumerable small stars, without producing the slightest noise, and left in the sky, what was long of disappearing, a luminous band, having all the various colors of the rainbow. The light of the moon, which was then in her last quarter, obscured this appearance. It sometimes seemed as if the heavens were cleft asunder, and in the opening, there appeared long brilliant bands of a white color. At other times flashes of lightning rapidly traversed the vault of heaven, eclipsing the light of the stars, and causing these long luminous bands of varied colors to appear. These phenomena continued to succeed each other without occasioning the slightest perceptible noise. They were in their greatest splendor between five and six o'clock in the morning, and continued without interruption till sunrise. They were observed

principally by the sentinels, and by the officers, when going their rounds; also by the ecclesiastics, and by the subordinates, and by many other persons. Monsieur Milordou, the principal priest of the cathedral, stated in the account which he gave of this occurrence, that the interior of the cathedral was sometimes suddenly illuminated by the light of this brilliant phenomenon. Monsieur Itschitow, lieutenant-colonel of the 3d battalion of the line of Orenburg, also confirmed these statements in his report, which as an additional ground of confidence, contained the accounts of the sentinels in the several positions in which they had been posted. During the same night, and almost at the same hour, a not less remarkable appearance was witnessed at Hitzkaja-Saschtschita, about seventy-five miles to the south of Orenburg. Two columns of a white color rose from the horizon equidistant from the moon, which at the time had not risen far; about the middle of their height they appeared brilliant and much curved. Several horizontal bands sprung from this point, the most brilliant of which extended towards the moon, in which they appeared to unite, so that in this way they appeared to form a great H. In the town of Ufa, the seat of the government of the same name, situated 380 miles to the north of Orenburg, a phenomenon similar to that which was observed at Hitzkaja-Saschtschita, was perceived, but, according to the accounts which have been given, it was not quite so brilliant."—*Edin. new Philo. Jour. July*, 1836.

13. *Declination and Inclination of the Magnetic Needle at Paris.*—On the 9th of November, 1835, at 1*h.* 8′ P. M. we found that the northern extremity of the magnetic needle pointed to the west of the astronomical north, 22° 4′. On the 3d of July, 1835, at 9*h.* morning, the inclination was 67° 24′.—*Arago in the Annuaire*, 1836, *p.* 349.

14. *Progressive Rise of a portion of the bottom of the Mediterranean.*—M. Theodore Virlet lately addressed a note to the French Academy of Sciences, in which he directed the attention of geologists to the probability of the speedy appearance of a new island in the Grecian Archipelago, in consequence of the progressive rise of a sunken solid rock, (composed of trachytic obsidian?) in the gulf of the volcano of Santorin. The following are the author's observations on this subject:—" Towards the end of the last century, at the peri-

od when Olivier visited Santorin, the fishermen of the island asserted that the bottom of the sea had recently risen considerably between the island of Little Kaïméni and the Port of Thera; in fact the soundings did not give a greater depth than fifteen to twenty fathoms, where formerly the bottom could not be reached. When Colonel Bory and the author visited the island in 1829, they were able not only to confirm the truth of Olivier's statement, but also to ascertain by various soundings, that the rise of the submarine land had continued, and that at the point indicated the depth was not more than four fathoms and a half. In 1830, the same observers made new soundings, which enabled them to determine the form and extent of the mass of rock, which in less than a year had been elevated half a fathom. It was found to extend 800 metres from east to west, and 500 from north to south. The submarine surface augmented gradually to the north and west, from four to 29 fathoms, while to the east and south this augmentation amounted to forty-five fathoms. Beyond this limit, the soundings indicated in all directions a very great depth. I have lately been informed that Admiral Lalande, who, since 1830, has twice returned to Santorin, ascertained that the rock still continues to rise; and that, in September, 1835, the date of his last visit, the depth of water amounted to only two fathoms, so that a sunken reef now exists which it is dangerous for brigs to approach. If the rock continues to rise at the same rate, it may be calculated that in 1840, it will form a new island, without, however, those catastrophes which this phenomenon seems to presage for the gulf of Santorin, being a necessary consequence of the epoch of its appearance at the surface of the water. Since the eruptions of 1707, and 1712, which produced the new Kaïméni, volcanic phenomena have completely ceased in the gulf of Santorin, and the volcano seems at the present day quite extinct. Nevertheless, the rise of a portion of its surface seems to demonstrate continual efforts to make an eruption during fifty years; and that, whenever the resistance shall not be strong enough to offer a sufficient obstacle, the volcano will again resume its activity."—*Edin. New Phil. Jour. July,* 1836.

15. *Hail.*—After a violent storm at Clermont, MM. Bouillet and Lecoq found a number of hail-stones as large as hens' eggs, and some others as large as those of turkeys. They were all of an ellipsoidal form, and seemed formed of a multitude of needles, united to the extremities of the great axis. They were from eight lines to

two inches long. Those needles, on which the fusion had not made much impression, still showed traces of hexagonal prisms, terminated by prisms of six facets. In a second storm, others fell which were not larger than hazel nuts, and these were formed of concentric layers, more or less transparent, rounded, or slightly oval, and possessed a powerful horizontal motion; they were heard to hiss in the air, as if each hail-stone rubbed against the other, and their rotation was extremely rapid.—*Athenæum.*

16. *New Animal.*—A new genus of Mammalia has been found in Madagascar, by M. Goudot, which M. Doyère, Professor at the College of Henri Quatre, proposes to call *Eupleres.* It is a lively, swift animal, with slender legs, and entirely Plantigrade, the sole of the foot being the only part free from hair. It lives on the surface of the ground, is long and thin in the body, and its girth is that of most Insectivora. If any judgment may be formed from its anatomy, its hearing is equal to that of other Insectivora; and the size of its orbits shows that its sight is likely to be good. The thumb is much the shortest of its five fingers, and all are armed with sharp, thin, and semi-retractile nails. The natives say that it hollows out the sand, and lives in pits. Flacourt mentioned this animal under the name of Falanou, and thought it to be a civet, which error has been continued in several works. The animal we now speak of was too young to have completed its dentition, but at present it has six incisors in the upper jaw, two canines, six pointed grinders, and four tuberculous grinders in the under jaw; eight incisors, two canines with a double root, fitting behind those of the upper jaw, like the mole, four pointed grinders, and six with five tubercles in the lower jaw. M. Doyére gives the specific name in honor of M. Goudot, and writes it *Eupleres Goudotii.*—*Athenæum.*

17. *Ornithology.*—A new bird belonging to the *Passeres,* and among the *Upupæ,* has been found at Madagascar, by M. Goudot, and forms the type of a new and remarkable genus. The beak is very long, arched, compressed or flattened, like a blade, and may be compared to that of a small sythe. The nostrils, placed at the base of the beak, and pierced laterally, are not covered by the anterior feathers of the head. The wings, which in length reach the middle of the tail, according to the nomenclature of M. Isidore Geoffroy, belong to the type called by him *surobtus,*—that is, having the

fourth and fifth remiges the longest of all. The first like that of the Hoopoes, is extremely short, and nearly useless in flight. The tail is square, and composed of twelve pens; the externals of which have their stems prolonged, in a very slight degree, beyond the barbs. The feet have three toes, directed forwards, and a fourth backwards. All are long, thick, and furnished with curved talons, enlarged at the base by a thick membrane, which has some affinity with that of the Grallæ. The only species now known has the head, the neck, and the under part of the body white; the back, wings, and tail, of a greenish black, with metallic lights. M. Isidore Geoffroy has named it *Falculia palliata.* It lives on the borders of streams, feeds on small aquatic insects, and the organic remains found in mud.—*Athenæum.*

18. *The tongues of ducks*, I learned to-day, are among the dainties of Chinese epicures. In one of the lanes running westward from Leuenhing keae, there is a shop containing a great variety of live fowls, besides several species of dried ones, for sale. One article puzzled me much; and by inquiry I found it to be nothing more nor less than a string of dried tongues, obtained from ducks. They were stretched out to the utmost length, resembling awls in shape, and hardened almost to the firmness of iron.—*Thursday, Nov.* 12*th.*—*Chinese Repository.*

19. *Locusts.*—The Egyptian plague of locusts made their appearance in Kwangse, and the western departments of Kwantung, about the 20th of July, 1835. A small advance guard having come as far as Canton, orders were issued to the military and people to exterminate them, as was done when they made their appearance here in October, 1833. As this was much easier said than done, the next resort was to the more rational mode of offering a bounty of twelve or fifteen cash per catty for the locusts. But during the late strong winds, the locusts are said to have been driven before it in such quantities and into such places, that the catchers of them seemed likely to realize some profit from the bounty. But true to Chinese prudence, the officers then immediately lowered the bounty, and would give but five or six cash per catty. The damage occasioned by these insects is very great, and the Chinese always dread their approach. A swarm will destroy a field of Rice in a short time, leaving the former green prospect an unsightly marsh. The Chinese affirm that the

leader is the largest individual in the whole swarm, and that the rest follow all his motions. Some stragglers have made their appearance in the hongs, which were from two and a half to three inches long, strongly limbed, and agreed with the popular description given of the Egyptian locusts. The natives regard the insect, when deprived of the abdomen and properly cooked, as passable eating, though they do not appear to hold a dish of locusts in much estimation.—*ib.*

20. *Memorandum of an excursion to the tea hills, which produce the description of tea known in commerce under the designation of Ankoy* (*Nganke*) *tea;* by G. J. Gordon, Esq.—" Having been disappointed in my expectations of being enabled to visit the Bohea hills, I was particularly anxious to have an opportunity of personally inspecting the tea plantations in the black tea district, of the next greatest celebrity, in order to satisfy myself regarding several points relative to the cultivation, on which the information afforded by different individuals was imperfect or discordant.

" Mr. Gutzlaff accordingly took considerable pains to ascertain for me, from the persons who visited the ship, the most eligible place for landing with the view of visiting the Ankoy hills; and Hwuytow bay was at length fixed upon as the most safe and convenient, both from its being out of the way of observation of any high Chinese functionaries who might be desirous of thwarting our project, and from its being equally near the tea hills as any other part of the coast at which we could land."

" The wind being unfavorable, we made rather slow progress by rowing, but taking for our guidance the masts of some of the junks which we observed lying behind a point of land, we pulled to get under it, in order to avoid the strength of the ebb tide, which was now setting against us. In attempting to round the point, however, we grounded, and soon found that it was impossible to get into the river on that side, on account of sand banks which were merely covered at high water, and that it was necessary to make a considerable circuit seaward to be able to enter. This we accomplished, but not till 1, A. M. At this time a light breeze fortunately springing up, we got on very well for some time, but were again obliged to anchor at ¼ past 2, from want of water. As the tide rose, we gradually advanced towards the town of Hwuytow, till we came to one of those bridges of which there are several along the coast, that extend over wide sand flats that are formed at the mouths of the rivers.

These bridges are constructed of stone piers with slabs of stone laid from pier to pier, some extending over a space of 25 feet and upwards, and others being from 15 to 20 feet span. As the length of this bridge cannot be less than three quarters of a mile, the whole is very striking as a work of great labor, if not exhibiting either much skill or beauty. We were informed by some boat people that we should not find water to carry us beyond the bridge, but observing some tall masts on the other side, we resolved on making the experiment, and pushing on as far as we could. It was almost dark when we passed under the bridge, and we had not proceeded far when we were again aground. This, however, we attributed to our unacquaintance with the channel, and as the tide floated us off, we continued advancing, notwithstanding the warning of a friendly voice from the bridge, that entreated us to return to the town, promising us comfortable quarters, and a guide, &c. Being rather distrustful of the motives of this advice, however, we proceeded for some time longer, but at length found it impossible to proceed farther, the ebb having at the same time commenced. We therefore spread an awning, and prepared to make ourselves as comfortable as possible for the night. The day had been the warmest we had experienced for a month past, but the night was very cold, and our boat, as may be imagined, far from commodious for so many people. At daylight, we found that there was not six inches of water in any part of the channel, and from the boat we stepped at once upon dry sand. The survey from the bank showed plainly that it would be impossible to proceed any further by water. We accordingly prepared to march on foot, taking with us three lascars, who might relieve each other in carrying our cloak-bag of blankets and great coats, as well as some cold meat. We ordered the people to prepare a meal as fast as possible, intending to make a long stretch at first starting, and Mr. Nicholson was directed to remain in charge of the boat with five lascars, to move her down under the bridge on the return of the flood, and there to await our return for four or five days. Crowds of people now began to gather around the boat, moved by mere curiosity. Mr. Gutzlaff induced some of them to get ducks and fowls for the use of the boat's crew, and strange to say, prevailed on one man to become our guide, and on two others to undertake to carry our baggage, as soon as we should be a little farther off from the town, and out of the way of observation."

"Skirting the town of Hwuytow, we proceeded in a N. N. E. direction, at a moderate pace, for an hour and a half, when we stopped at a temple, and refreshed ourselves with tea. Nothing could be more kind or more civil than the manners of the people towards us hitherto, and if we could have procured conveyances here so as to have escaped walking in the heat of the day, loaded as we were with heavy woollen clothes, we should have had nothing further to desire: as it was, my feet already began to feel uncomfortable from swelling, and after another hour's march, I was obliged to propose a halt till the cool of the evening. Fortunately we found, however, that chairs were procurable at the place, and we accordingly engaged them at half a dollar each. They were formed in the slightest manner, and carried on bamboo poles, having a cross bar at the extremities, which rested on the back of the bearer's neck, apparently a most insecure as well as inconvenient position; but as the poles were at the same time grasped by the hands, the danger of a false step was lessened. We had not advanced above a mile and a half before the bearers declared they must eat, and to enable them to do so, they must get more money. With this impudent demand we thought it best to comply, giving them an additional real each. After an hour's further progress, we were set down at a town near the foot of the first pass which we had to cross. There the bearers clamorously insisted on an additional payment before they would carry us any further. This we resisted, and by Mr. Gutzlaff's eloquence gained the whole of the villagers, who crowded around us, to join in exclaiming against the attempted extortion. Seeing this, the rogues submitted, and again took us up. Mr. G. mentioned that while we were passing through another village, the people of which begged the bearers to set us down, that they might have a look at us, they demanded 100 cash as the condition of compliance. The country through which we passed swarmed with inhabitants, and exhibited the highest degree of cultivation, though it was only in a few spots that we saw any soil which would be deemed in Bengal tolerably good; rice, the sweet potato, and sugar cane, were the principal articles of culture. We had now to ascend a barren and rugged mountain, which seemed destined by nature to set the hand of man at defiance; yet even here, there was not a spot where a vegetable would take root, that was not occupied by at least a dwarf pine planted for the purpose of yielding fire wood, and a kind of turpentine; and wherever a nook presented an opportunity of gaining a few

square yards of level ground by terracing, no labor seems to have been spared to redeem such spots for the purpose of rice cultivation. In ascending the pass, we soon came to places where it was difficult for our bearers to find a footing, and where they had consequently to pick out their steps as they advanced. To assist themselves, they gave the chair a swinging motion, with which they kept time in raising their feet. This was far from agreeable, and the first impression was that it was done merely to annoy, but we very soon saw that the object was different. The highest point of the pass I should conjecture to be about 1200 feet above the plain, and the descent on the north side to be nearly equal to the ascent from the south, say 1000 feet. At half past four we arrived at a rather romantic valley, which was to be our halting place for the day."

"Nov. 12th. Got into our chairs at a quarter past six, A. M. and proceeded along a narrow rugged dell towards Koëboë. Several nice looking hamlets were seen on the way. The people were engaged in reaping the rice, which seemed heavy, and well filled in the ear. In several places I observed that they had taken the pains to tie clumps of rice together for mutual support. Sugar cane is bound in the same way, and for additional security, the outside canes are mutually supported by diagonal leaves, which serve at the same time to form them into a kind of fence. The leaves are not tied up round the stalks as in Bengal; the cane is slender, white, hard, and by no means juicy or rich; yet, abating the black fungous powder, which is very prevalent, the surface is healthy, and close growing in a remarkable degree. We arrived at Koëboë at eight o'clock, and finding we could get water conveyance for part of the way on which we were proceeding, we engaged a boat for that purpose. After a hearty breakfast, we embarked at 10 A. M. amidst crowds of people who covered the banks of the river at the ghát. On inquiry, we found that the river on which we were proceeding in a W.N.W. course, was the same which passed Nganke heën, and flowed to Tseuenchow foo. The boat was large, but light, and being flat bottomed, drew very little water. The stream was so shallow, that it was only by tracing the deepest part of the channel from side to side of its bed, that we were able to advance at all. This was done by poling; in several places the stream was deepened by throwing up little banks of sand so as to confine its course within a channel merely wide enough for the boats to pass through. I estimated the width from bank to bank at 200 yards, and should judge

from the height at which sugar is cultivated above the level of the present surface, that the greatest depth in the rainy season does not exceed 10 feet. Being entirely fed by mountain torrents, its rise must be often very sudden, but I did not observe any traces of devastation in its course. Its name, Nganke, or 'peaceful stream,' is probably derived from this circumstance: the valley on each side seemed well cultivated, the banks being principally occupied by sugar cane. At every village the people poured out as usual to see us, vying with each other in marks of civility and kindness. The day, however, becoming very hot, we took shelter from the sun under the roof of the boat, to the disappointment of many who waded into the water to gratify themselves with a sight of the strangers. Coming at last to a high bank close to a populous town, they actually offered the boatman 400 cash if he would bring us to; and on his refusal, the boys began pelting the boat with clods and stones. On this, Mr. Gutzlaff went on deck to remonstrate, and Mr. Ryder to intimidate with his gun. Betwixt both, the effect was instantaneous, and the seniors of the crowd apologized for the rude manner in which the boys had attempted to enforce the gratification of their curiosity. We had been in vain looking out all yesterday and to-day for a glimpse of tea plantations on some of the rugged and black looking hills close in view, though at almost every place where we halted, we were assured that such were to be found hard by."

"Arrived at Toä-be, we were hospitably received by the family of our guide, and soon surrounded by wondering visitors.

"Mr. Gutzlaff speedily selected one or two of the most intelligent of them, and obtained from them ready answers to a variety of questions regarding the cultivation of the tea plant. They informed him that the seed now used for propagating the plant was all produced on the spot, though the original stock of this part of the country was brought from *Woo-e-shan;* that it ripened in the 10th or 11th month, and was immediately put into the ground where it was intended to grow, several being put together into one hole, as the greater part was always abortive; that the sprouts appeared in the 3d month after the seeds were put into the ground; that the hole into which the seeds are thrown is from three to four inches deep, and as the plants grow, the earth is gathered up a little around the root; that leaves are taken from the plants when they are three years old, and that there are from most plants four pluckings in the year. No manure is used, nor is goodness of soil considered of consequence; neither

are the plants *irrigated*. Each shrub may yield about a *tael* of *dry* tea annually (about the 12th of a pound.) A *mow* of ground may contain 300 or 400 plants. The land tax is 300 cash, (720 to a dollar,) per mow. The cultivation and gathering of the leaves being performed by families without the assistance of hired laborers, no rate of wages can be specified ; but as the curing of the leaf is an art that requires some skill, persons are employed for that particular purpose, who are paid at the rate of one dollar per pecul of fresh leaves, equal to five dollars per pecul of dry tea. The fire-place used is only temporary, and all the utensils, as well as fuel, are furnished by the curer of the tea. They stated that the leaves are heated and rolled seven or eight times. The green leaf yields one fifth of its weight of dry tea. The best tea fetches on the spot 23 dollars per pecul, ($133\frac{1}{3}$ lbs.) and the principal part of the produce is consumed within the province, or exported in baskets to Formosa. That the prevailing winds are northwesterly. The easterly winds are the only winds injurious to the plants. Hoar frost is common during the winter months, and snow falls occasionally, but does not lie long, nor to a greater depth than three or four inches. The plant is never injured by excessive cold, and thrives from 10 to 20 years. It is sometimes destroyed by a worm that eats up the pith, and converts both stem and branches into tubes, and by a gray lichen which principally attacks very old plants. The period of growth is limited to six or seven years, when the plant has attained its greatest size. The spots where the tea is planted are scattered over great part of the country, but there are no hills appropriated entirely to its culture. No ground, in fact, is formed into a tea plantation, that is fit for any other species of cultivation, except perhaps that of the dwarf pine already alluded to, or the *Camellia oleifera*. Mr. Gutzlaff understood them to say that the plant blossoms twice a year, in the eighth moon or September, and again in winter, but that the latter flowering is abortive. In this I apprehend there was some misunderstanding, as full sized seeds, though not ripe, were proffered to me in considerable quantities early in September, and none were found on the plants which we saw. I suspect that the people meant to say that the seeds take eight months to ripen, which accords with other accounts. We wished much to have spent the following day (the 13th) in prosecuting our inquiries and observations at Toä-be and its neighborhood, but this was rendered impracticable by the state of our finances. We had plenty of gold, but no one could be

found who would purchase it with silver at any price. We therefore resolved on making the most of our time by an early excursion in the morning, previous to setting out on our return.

"We accordingly got up at day break, and proceeded to visit the spot where the plants were cultivated. We were much struck with the variety of the appearance of the plants: some of the shrubs scarcely rose to the height of a cubit above the ground, and those were so very bushy that the hand could not be thrust between the branches. They were also very thickly covered with leaves, but these were very small, scarcely above $\frac{3}{4}$ of an inch long. In the same bed were other plants, with stems four feet high, far less branchy, and with leaves $1\frac{1}{2}$ to 2 inches in length. The produce of great and small was said to be equal. The distance from centre to centre of the plants was about $4\frac{1}{2}$ feet, and the plants seemed to average about two feet in diameter. Though the ground was not terraced, it was formed into beds that were partly levelled. These were perfectly well dressed, as in garden cultivation, and each little plantation was surrounded by a low stone fence, and a trench. There was no shade, but the places selected for the cultivation were generally in the hollows of hills, where there was a good deal of shelter on two sides, and the slope comparatively easy. I should reckon the site of the highest plantations we visited to be about 700 feet above the plain, but those we saw at half that height, and even less, appeared more thriving, probably from having somewhat better soil, though the best is little more than mere sand. I have taken specimens from three or four gardens. Contrary to what we had been told the preceding night, I found that each garden had its little nursery, where the plants were growing to the height of four or five inches, as closely set as they could stand; from which I conceive that the plant requires absolutely a *free* soil, *not wet*, and *not clayey*, but of a texture that will retain moisture; and the best site is one not so low as that at which water is apt to spring from the sides of a hill, nor so high as to be exposed to the violence of stormy weather. There is no use in attempting to cultivate the plant on an easterly exposure, though it is sufficiently hardy to bear almost any degree of dry cold."—*Ib.*

Note.—Since the notes on p. 36 were printed, Dr. Kirtland has become satisfied from the anatomical structure of the animals, that the H. fuliginosa and H. glaphyra, are distinct species.

Moore's Lithog.y Boston (successor to Pendleton)

DR. PRINCE.

From a painting by F. Alexander.

THE

AMERICAN

JOURNAL OF SCIENCE, &c.

Art. I.—*Memoir of Rev. John Prince, LL. D.*, late Senior Pastor of the First Church in Salem, Mass.; by Rev. Charles W. Upham.

Dr. Prince was born in Boston, on the 22d of July, 1751. His parents resided in the north part of the city, and were worthy and excellent members of the religious society distinguished as the New North Church. They were of Puritan descent, and, as was the case with all who worthily claimed that name, were careful to give their son a good education, and to impress upon his mind a reverent sense of religious truth and duty. His father being a mechanic, a hatter by trade, the son was directed to a similar pursuit. He was early bound out as an apprentice to a pewterer and tinman, and continued industriously and faithfully to labor in his calling until his indentures had expired.

But his genius, from the beginning, had indicated a propensity to a different mode of life. From a child his chief enjoyments were found in books. He was wont to retire from the sports of boyhood. There was no play for him to be compared with the delight of reading. During the hours of leisure, in the period of his apprenticeship, he sought no other recreation than in the acquisition of knowledge.

It followed of course, that, upon becoming free, he abandoned his trade and devoted himself to study. In a very short time he was prepared to enter college, and received his bachelor's degree at Cambridge, in 1776, at the age of twenty-five. After leaving college, he was engaged for some time in the instruction of a school. He pursued the study of divinity under the direction of the Rev. Samuel Williams, of Bradford, Mass., a clergyman highly distin-

guished for talents and attainments, afterwards Professor of Mathematics and Natural Philosophy in Harvard University. He was ordained over the First Church in Salem, on the 10th of November, 1779. On the 8th of December, 1824, the writer of this notice was settled as his colleague. He died on the 7th of June, 1836, having nearly completed his 85th year. His ministry lasted 57 years and 7 months.

The disease of which Dr. Prince died was stone in the kidney, producing frequent and violent attacks of strangury, for twelve years. It was, of course, distressing in the highest degree, accompanied by an impaired function, and ending in the entire destruction of the organs affected by it. It is very remarkable, however, that in all other respects, time and suffering seemed to have failed to make any impression upon his system. His appetite, organs of digestion, eyesight, and general activity, either of sense, or muscle, or nerve, were not in the slightest degree impaired; and this was still more observable, inasmuch as from early life, and for more than fifty years, he had been afflicted with a severe cough, and a double hernia. His extraordinary enjoyment of general health, notwithstanding these local infirmities, can only be accounted for by the serenity and cheerful equableness of his feelings and spirits, partly owing to a happy natural temperament, and partly to the benign influence of his scientific and philosophical pursuits.

When Mr. Prince was preaching as a candidate, in Salem, in 1779, his cough was so violent, that serious apprehensions were felt that he would soon sink into a decline. At the meeting, called for the purpose of seeing whether the society of the First Church would give him a call to settle, the following curious incident occurred. One of the parish, before the vote was put, rose and remarked, that he entirely concurred with all the rest of the society in admiring Mr. Prince very much as a man and a minister, but doubted about the expediency of settling him, as his complaints were so alarming that, in all probability, they would soon be called to bury him. Another member, who was a physician, in reply, admitted that Mr. Prince was in delicate health, but expressed the opinion that he might get over his complaints; and, after having earnestly advocated his settlement, concluded his argument by saying that he should not be surprised if, after all, Mr. Prince should live to bury the whole of them. The extravagant expression turned out to be a true prediction. He did live to bury them all. These circum-

stances in reference to Mr. Prince's state of health, constitutional infirmities, and the disease which finally terminated his life, have been particularly mentioned, as illustrative of the power of philosophical pursuits, and a perfectly regulated and equable state of the feelings and temper to prolong life, even in opposition to the most unfavorable influences.

The basis of Dr. Prince's philosophical attainments was laid in the thirst for knowledge already alluded to. This trait was early developed, and continued to be his most marked characteristic until the very hand of death was upon him. It was exercised in almost every possible direction, and as his memory was wonderfully capacious and retentive, the result was that he accumulated and had at command as large an amount of knowledge, as can easily be found in the possession of any one mind. Without taking into the account what he derived from books, and few men have ever read more, his eyes and his ears were always open and his hands were always busy. No idle moment ever passed over him. He noticed every occurrence, and explored every object within the reach of his curious observation. When a mere boy he was intent to learn all that was going on in the great world around him; and this appetite for knowledge enabled him to lay up a body of reminiscences, drawn from his early youth and from every period of his life, which made him, in his old age, a truly instructive companion. He was an attentive and inquisitive spectator of the opening scenes of the revolutionary drama in Boston, from the massacre through all the intermediate events, including the destruction of the tea, to the battles of Lexington and Bunker Hill. He was equally well stored with facts in reference to men and things during all the subsequent period of his life; and what he knew, he related, in a style of narrative, such as those who enjoyed his acquaintance, can scarcely expect ever to find equalled.

In this connection it is necessary to remark, as it was indeed a most distinguishing trait in the character of Dr. Prince, and one worthy of imitation by all men, and especially by clergymen, that vigorous, unremitted, and universal as was his thirst for knowledge, it was invariably kept within the bounds of prudence, propriety, and good feeling. Probably no man ever lived more free from the charge of being a prier into other persons' affairs, or a tattler of their failings. He did not appear to have a sense to discern the private frailties or follies of men. His lips were never known to circulate

scandal or gossip. During his long ministry, I do not believe that he has ever been even suspected of widening a breach by tale-bearing, of raising a laugh at another's expense, or of uttering a syllable to the disparagement of a single member of the community. All the notices he took, and all the circumstances he related, in which other men were concerned, were only such as could be made to point a general moral, and illustrate a principle of human nature without affecting any individual injuriously. What I have now said will commend itself to his friends as a true and accurate feature of his character, and it strikingly illustrates his judgment and prudence, the integrity of his mind, the tenderness of his feelings, and his strong sense of justice towards all men.

His passion for knowledge, receiving a particularly strong bias from the manual occupation to which he served an apprenticeship, inclined him, with peculiar interest, to the pursuit and cultivation of the several branches of experimental natural philosophy. On the 10th of November, 1783, just four years from the day of his ordination, when 32 years of age, he communicated to the scientific world, his improved construction of the Air Pump. His letter giving the first account of it, addressed to President Willard, of Harvard College, may be seen in the first volume of the Memoirs of the American Academy. The present generation can form no conception of the interest awakened by this admirable invention, not only in this country, but throughout Europe. His name was at once enrolled among the benefactors and ornaments of modern science, and on that roll it will remain inscribed until science itself shall be no more. The philosophical journals of the day emulated each other in praising the scientific research and profoundness of reasoning displayed in the construction. The American philosopher was allowed to have surpassed all former attempts in the same department. His name is recorded, by an eminent writer, in connection with that of the famous Boyle, among "those who have improved the instruments of science and of whose labors we are now reaping the benefit."* The machine is still called, by way of distinction, "the American Air Pump," and its figure was selected to represent a constellation in the heavens, and imprinted upon celestial globes.

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* Lectures on Natural and Experimental Philosophy, by George Adams—London, 1799, vol. 1, p. 44--54. Rees' Cyclopædia, Art. Air Pump. Analytical Review, July, 1789. Nicholson's Journal, vol. 1, p. 119. The best account of the American Air Pump is to be found in Dobson's Supplement to the Encyclopædia Brittannica, Art. Pneumatics.

His reputation was thus established among the first philosophers and mechanicians of his age. He received the honorary degree of Doctor of Laws from the very respectable college at Providence, and was admitted to the several learned and philosophical societies of the country.

It is extremely difficult, if not impossible, to do justice to Dr. Prince's claims upon the gratitude of the scientific world. His modesty and indifference to fame were so real and sincere, that it never occurred to him to take pains to appropriate to himself the improvements and discoveries he had made.

Fortunately for the cause of science, his whole philosophical and literary correspondence has been preserved. All his own letters, and many of them are very elaborate and minute, containing full discussions, and, frequently, drawings executed by the pen, were carefully copied out into manuscript volumes. These manuscript volumes, which are eleven in number, are the monuments of his genius, and the only record of his contributions to the cause of science. It was his custom, when he had made an improvement in the construction and use of a philosophical instrument, instead of publishing it to the world, to communicate a full description of it, by private letter, to the principal instrument makers in London. During his whole life, down to March 19th, 1836, the date of his last letter to Samuel Jones of London, he has, in this manner, been promoting the interests of science, while his agency, to a very great extent, has been unknown to the public.

A long letter, occupying ten closely written pages, is found under the date of Nov. 3d, 1792, addressed to George Adams, of London, and containing a full description of an improved construction of the Lucernal microscope. On the 3d of July, 1795, he wrote another letter to Mr. Adams, describing still further improvements in the same instrument. Without making any public acknowledgment of his obligations to Dr. Prince, Mr. Adams proceeded to construct Lucernal microscopes upon the plan suggested by him. Shortly after the death of Mr. Adams, which occurred in the latter part of 1795, an article appeared in the Gentleman's Magazine, signed by John Hill, a distinguished cultivator of science, in which the importance of these improvements was shown at large, and illustrated by a plate. The writer stated that he had procured his instrument from Mr. Adams a short time before his death, and that Adams intimated to him at the time, that he had been indebted for some im-

portant suggestions in its construction, to "a clergyman." The purpose of Mr. Hill's communication seemed to be, in part to make known the improvement, and in part to draw out the clergyman who invented it. Dr. Prince's attention was directed to Mr. Hill's publication by his London correspondent, but I do not find that he answered the enquiry, at the time, or took any steps to secure the credit, with the readers of the Gentleman's Magazine, of the beautiful and truly ingenious construction which had attracted so much curiosity and admiration. He, probably, preferred to let the subject drop, rather than keep it before the public to the disadvantage of the memory of his friend.*

After the death of Mr. Adams, his successor in business, Mr. Wm. Jones, sought Dr. Prince's correspondence in language of which the following is a specimen, extracted from a letter, dated London, Feb. 18, 1797:

"A correspondence with you, sir, will be as flattering to me as it is desirable. I have long heard of your knowledge and expertness in science, and shall be happy to receive any communications that have resulted from your study and experience."

In a letter, dated July 3d, 1797, Mr. Jones repeats his solicitations as follows: "Your celebrity as a philosopher is not a little known in this country. Mr. Jefferson many years ago, mentioned your name to me, and showed me the description of your air pump. A correspondence with you respecting science and instruments, will be highly gratifying to me, and what small leisure an unremitting attention to business will permit, I shall be happy to snatch occasionally for your information."

The correspondence, thus commenced with this enlightened and philosophical mechanician, was continued with him, and after his death, with his brother, without intermission, to the close of Dr. Prince's life, and became the foundation of a sincere and most interesting friendship. It is indeed delightful to witness the genial influence of scientific pursuits upon the affections, binding together the hearts of those between whose persons an ocean had always rolled.

The letters of Messrs. William and Samuel Jones are full of expressions of admiration and gratitude towards Dr. Prince. In one

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* Gentleman's Magazine, vol. 66, 2d part, 1796, pp. 897, 1080. When Mr. Dobson of Philadelphia, published the Supplement to the Encyclopædia Brittannica, Dr. Prince caused Mr. Hill's description to be reprinted in it, under the article OPTICS.

of them, dated March 3, 1798, Mr. Jones says, "It is to you that the Air Pump and Lucernal owe their present state of perfection and improvement." In another, dated September 29, 1798, he says, "In all respects I think you have made the Lucernal as complete and as simple as it can be made." Under the date of March 4, 1798, Mr. Jones acknowledges the adoption of Dr. Prince's "very useful and ingenious emendations" in the construction of the "astronomical lantern machinery."

Thus a constant intercommunication of friendly offices was kept up for nearly forty years. The correspondence is creditable to the Messrs. Jones in every point of view. On the part of Dr. Prince, it contains a body of instruction such as can no where else be found, and would be regarded as an invaluable directory, by all whose business or whose pleasure it is to make use of the instruments of science.

When we consider the situation of Dr. Prince, conducting his investigations and experiments in solitude, far removed from the great centers of scientific research and observation, and having to communicate with other philosophers by the tedious and unsatisfactory means of epistolary correspondence beyond the ocean, it becomes truly astonishing to reflect upon the success and amount of his labors. Until long after his great invention of the improved air-pump, he had depended almost wholly upon his own toil and ingenuity in the construction of scientific instruments, not having, at that time, established a correspondence with the London machinists. He had, of course, to struggle against many inconveniences, from which a vicinity to the London workshops would have exempted him. There is a great amount of floating knowledge accumulated and mutually communicated where many persons are kept for a long time employed in any branch of business, and which, never being recorded in books, the self-taught and solitary operative will not be likely to acquire.

The following passage, extracted from a letter written by Dr. Prince to President Fitch, of Williams College, Sept. 24, 1795, will illustrate the trials and difficulties to which he was subjected in the construction of philosophical instruments—it refers to an equatorial.

"On my return home, the ingenious young man, whom I have always employed to do my brass work, and who had begun the brass box for the needle, could not finish it immediately. His

brother who worked with him, was very sick of a fever, and required all his attention. The brother died. In two days more he took the fever himself, and died in ten days, and left me destitute of workmen to finish the matters I had undertaken. I got the instrument from his shop as soon as I could in the unfinished state, and went to work myself to complete it; and when I had done it to my own satisfaction, as I supposed, to my great disappointment and mortification, I found all the labor was lost. For, on putting the needle into the box, which is of a parallelogram form, about six tenths of an inch in width, I found the box, though made of brass, attracted the needle to its side and would not allow it to play freely. This was a circumstance entirely new and unexpected. I never had an idea of any kind of brass being magnetic, and could not account for the phenomenon for some time. But on trying several other pieces I found that the box was not the only one that attracted the needle. Several pieces did the same; others did not. This quality must be owing to the impurity of the brass. Some steel filings or small particles of iron must have accidentally mixed with it in casting. It would have been fortunate for me if I had made the discovery before it was worked; but the thought never occurred to me. Too much of our knowledge (considering the shortness of life) comes to us by dear bought experience."

The foregoing extract may serve to give some idea of the great inconveniences to which Dr. Prince was put, as a philosophical mechanician, from the want of workmen, and from the necessity of accumulating for himself his own "dear bought experience," without obtaining any benefit from the experience of others.

In looking through these manuscript volumes, we perceive, from the beginning to the end, the evidences of his wisdom, ingenuity, and skill. In one of his letters (Sept. 24, 1795,) he recommends a new construction of thermometers, in which zero should be at the freezing point of mercury, thereby avoiding the inconvenience of having both plus and minus in the scale.

In another letter (Dec. 4, 1795,) he describes some improvements he had introduced in the construction of an equatorial.

Feb. 13, 1797, he gives an account of a magic lantern, contrived and constructed by him on a new and extensive scale.

He thus introduces the description of another of his inventions, in a letter to William and Samuel Jones, of London, Oct. 20, 1797—"I have lately constructed a very large microscope for my-

self upon a simple plan, the effects of which are surprisingly magnificent and beautiful. It is also a noble megaloscope as well as microscope, the field of view being an inch and a half diameter, with considerable magnifying power. The body of the instrument is four feet and a half in length, including the brass tubes at the end for the magnifiers. It is made in the form of an obelisk, and when it is not in use as a microscope it stands upright on its base; the tube in its top is unscrewed and a small urn is put in its place, so that it makes a handsome ornament in a room, and is more out of the way than if laid in a horizontal case."

In a letter, dated March 2d, 1801, he gives the Messrs. Jones a particular account, accompanied by models and diagrams, of additional improvements, made by him in the magic lantern.

In a letter to the same persons, Nov. 24, 1818, he describes a very important and beautiful improvement he had just made on Dr. Brewster's kaleidoscope. He constructed it in such a manner that it was brought to bear upon opake objects, and most splendid and magnificent were the combinations of dazzling colors thus brought to light—a world of wonders, the brilliancy and glory of which transcended all that the eye of man ever contemplated, or his imagination conceived, was revealed to view, as existing in the darkest and roughest metals and rocks beneath our feet.

The following extract is from a letter to the Messrs. Jones, Oct. 28, 1823. "I have sent you, in the same box with the telescope, part of a hydrostatic instrument which I began to make with some others several years ago, and now my health and age will not allow me to finish it. It is a combination of several instruments. I have made three of them for different colleges. It is much approved, and more are wanted. I thought that by sending the parts done, with their description and uses, and some models of the parts to be added, it would give you a better idea of it than a mere description alone."

Dr. Prince continued his labors, as a philosophical mechanician, to a very advanced age. He thus alludes to them, in a letter to the Messrs. Jones, May 26, 1826: "I have been so much pleased with the large solar microscope I made, of which I wrote you some account, that I am making another with a large enlightening lens. My age and infirmities will not permit me to make another after I have finished this. One experiment I make with it is very pleasing and much admired. It is an imitation of an eruption of a volcano, by burning Dutch sealing wax, which melts but does not run freely.

The ebullition and belching out of the matter, and the boiling in the crater which is formed, and the appearance of the black scoria are very striking."

He had another method of exhibiting a volcanic eruption, which was by a series of engravings, representing its successive stages, and subjected to the magic lantern or camera obscura.

Dr. Prince continued to resist the approaches of age and its infirmities, and to labor effectually in his workshop much longer than he anticipated when he wrote the letter from which the last extract was made. Five years afterwards he succeeded in accomplishing an object at which he had long been aiming.

In a letter to Messrs. Jones, July 10, 1800, he thus expresses himself: "I have seen Mr. Dowse's large telescope which you sent him. I think it an elegant and well executed instrument, and the mounting makes it very convenient in management. But with the greatest magnifying power there will be a tremor, when the hand has hold of the adjusting screw, which makes it very difficult to define the object; and indeed all instruments so large, and supported in the center, as telescopes generally are mounted, must be affected in this way in some degree, notwithstanding the bracing bar. A small motion in the atmosphere will also affect them. I tried this experiment with a gentleman for whom I imported one of your three and a half feet achromatic. Placing it on a firm table, in a room where the motion of the air could not affect it, with a high power, we placed a book at such a distance in the garden as that we could scarcely read the words by the best adjustment we could make; then, taking the telescope from the stand, and laying it on the table, firmly supporting it at both ends, we could read at the same distance very distinctly, and the book would bear moving farther off with distinct vision."

Dr. Prince brought his philosophical career to a close, by contriving a stand for a telescope by which the uncertainty always before introduced into the observations of astronomers, by the tremor and vibration here spoken of, is completely avoided. The telescope rests in a solid bed with perfect firmness, and at the same time is movable in every direction, and by the slightest touch of the finger. The following is the conclusion of the description given by him of this ingenious structure, as published by the American Academy of Arts and Sciences. "I made the brass work myself, and finished it on my birth day—eighty years old."

He was consulted by colleges, academies, and lyceums, in all parts of America, with reference to the collection of philosophical apparatus and libraries, and for nearly half a century was employed to select and import books and instruments for public institutions and for literary and scientific individuals. His letter-books contain correspondences held with the colleges at Cambridge, Providence, Brunswick, Dartmouth, Williamstown, Middlebury, Amherst, Burlington, Schenectady, Lexington in Kentucky, Greenville in Tennessee, and Charleston in South Carolina, and with academies or similar institutions in Philadelphia, New York City, Boston, Leicester, Monson, Westfield, Onondago, Byefield, and many other places. His agency in thus providing and diffusing the means of knowledge has been of incalculable service to the country. At some of our public institutions the most beautifully constructed philosophical instruments may be found, which are the work throughout of his own hands.

Besides descriptions of improvements contrived by him in the instruments of science, his letters contain equally minute accounts of the manner in which he used and worked them in the various experiments to which they were capable of being put; and sometimes he indulges in trains of philosophical speculation, in which his mind gives itself up to the guidance of his fancy and the impulses of his benevolent affections. The following curious reverie of his imagination illustrates the tone and spirit of his philosophy. It is from a letter written to a scientific and personal friend in Virginia, July 23, 1782, and is appended to a description of the great telescope of Herschel, then recently constructed.

"It is said the king took great pleasure in walking through this enormous tube before it was mounted. This may not enhance his greatness in the opinion of some any more than his visit to Sam. Whitehead's brewery, which Peter Pindar so ludicrously celebrates. But there is a point of view in which I think it will appear to be a more laudable act than that of a king marching through the ranks of his disciplined army. This instrument was for the improvement of science, and that for the destruction of mankind. And is it not a more laudable ambition too? for while the general, with his military machine, is, by barbarous deeds, adding a few acres more to his master's dominions, the philosopher is, without any expense to humanity, discovering new worlds. Oh, when will the time come when men will have no greater ambition than to improve the dignity and happiness of human nature, when the weapons of war shall perish

or be changed for those of agriculture and science? How often have I wished I had power to turn all hearts to the rules of christianity, and correct every passion and sentiment which does not accord with it. Then I would next turn every ship of war into a telescope of equal magnitude and power, and send its commander on a cruise to make discoveries in the ocean of the universe. But, stop! we must not anticipate the order and method of Providence, who, in his time, will, I doubt not, produce this revolution in favor of human nature."

Dr. Prince was eminently learned in almost every department of Natural Philosophy. And what he knew, it was his great delight to communicate. His visitors were introduced, through his admirable apparatus and specimens, to the wonders of Astronomy, Optics, Pneumatics, Botany, Mineralogy, Chemistry, and Entomology. Indeed there is nothing beautiful, brilliant, dazzling, or rich, in any department of the outward world, which the ingenuity and skill of man has yet been able to explore, that he did not spread out before them. And all was illustrated, explained, and set forth, with a facility, a clearness, a sprightliness of manner, which never failed to charm the admiring listener. As an experimental lecturer and operator, in his own parlor and surrounded by his private friends, he was never surpassed by any public professor of science. The delightful amenity and simplicity of his manners and spirit were in admirable harmony with the genius of science itself, and he never explored the glorious mysteries and glittering recesses of nature, without discerning, and causing all others to discern and adore, traces of the power and wisdom of its author. Wherever he walked with science there he walked with God. Whenever he led another into the hidden halls of nature's temple, he taught him to pay glad and admiring homage to the enshrined divinity.

Dr. Prince brought his scientific skill and learning to contribute to the diffusion of useful instruction and refined entertainment in a great variety of ingenious methods. He was as much interested in man, as in nature. His knowledge of the history and usages of nations was very extensive. All the arts of civilized and social life had engaged his study. In architecture, painting, and the fine arts generally, his taste was highly cultivated. His collection of engravings and specimens was very extensive and curious. By means of optical instruments he was enabled to make a most satisfactory display of all these treasures of knowledge. In the course of a winter's evening, his delighted visitor, sitting all the while quietly in his

chair, was enabled to inspect the temples and the structures of ancient and modern Rome, to explore the ruins of the old world, to traverse the streets of London, Paris, and St. Petersburgh, to visit the villas of Italy, and noblemen's seats in England, to watch the successive aspects of an eruption of Ætna or Vesuvius, and literally to survey the whole earth and the glories of it.

Thus did our venerable philosopher make science contribute to his own happiness and improvement, and to the happiness and improvement of his friends and acquaintances.

Dr. Prince was a very learned theologian. In all the facts, illustrations and reasonings that constitute the science of natural theology, his philosophical attainments gave him preeminence. He was also thoroughly versed in revealed religion. His views of the interpretation and general criticism of the scriptures were wise and comprehensive. Few divines have ever been so conversant with the history of opinions in the church. His acquaintance with the literature of theology was extraordinarily minute and exact. With the character, bearing, and general contents of every work of note, in our language, or in the Latin tongue, he was familiar. Having for more than half a century corresponded with the principal London booksellers and been in the constant receipt of their catalogues, he had enjoyed great facilities for the accumulation of a theological library, and was possessed of a most valuable, rare, and extensive collection of standard works.*

Although he was numbered among the liberal clergymen of the present day, his preaching, in reference to the doctrines inculcated, has I am inclined to think been but little, if at all, affected by any of the controversies of the last half century. His theological sentiments were always substantially the same, and would probably be found to harmonize very nearly with the views in which serious and candid christians of both parties, if they could get rid of the disturbing influence of names and phrases and sectarian lines of division, would discover themselves to be united. His preaching was rational, catholic, philosophical, and liberal, and although not calculated to be popular at the present day, was duly estimated and admired by our pre-

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* Dr. Prince's library, consisting of about 3,500 volumes, numerous engravings, specimens of art, curiosities of nature, and philosophical instruments of all sorts, either made or improved by his own hands, constituted it is probable, as rich, and various, and valuable a depository and treasury of literature and science, as have ever been possessed by a private gentleman in this country.

decessors. His appearance in the pulpit was venerable and impressive in the highest degree, and the tones of his voice were truly noble and melodious. His figure was tall, and although very much bent by age, remarkably graceful and dignified. His dress was conformed to the fashion of the old school, and a full head of hair, perfectly whitened by time, was gathered in curls above his shoulders, so as to resemble the wigs worn by our ancestors, for which it was often mistaken. He preached his last sermon about six weeks before his death, in the afternoon of the 17th of April; and the image of his hoary locks and benevolent countenance will not soon grow dim on the memories of those who have seen him in the sacred desk.

Dr. Prince's published sermons bear strong marks of his excellent abilities and learning. His discourse on the death of his early friend and beloved associate, Dr. Barnard, is an admirable production, and in some passages exhibits an almost unrivalled tenderness of sensibility and beauty of expression. "The Lord has taken away my friend, my brother, my companion and fellow-laborer in his vineyard. But he has gone to his heavenly father; and can I complain? I may weep for myself, but I cannot for him. I have followed him through many of the walks of life, and must follow him through death. I ask your prayers that I may be prepared for it." He has followed him through death. Their friends rejoice in the hope that they are again united to part no more.

The sermon, from which the above extract is taken, was preached in October, 1814. The following circumstances had made such an impression on Dr. Prince's mind, that he thought proper, in publishing the discourse, to record them in a note to the clause, "I have followed him through many of the walks of life." The note is here subjoined.

"It is a singular concurrence in our walks of life, and one that has some effect upon the social feelings, that we were educated at the same university, and, after we graduated, kept the same schools in the same town; studied divinity with the same clergyman; settled in the ministry in the same town; the same person preached our ordination sermons; and we received honorary degrees from the same university."

It is a singular continuation of this series of concurrences, that, in selecting a text for the funeral discourse on Dr. Prince, the writer of this notice, without any knowledge of the fact at the time, took the very same passage, (Zechariah i. 5.) from which the late Dr.

Wadsworth, of Danvers, preached Dr. Barnard's funeral sermon. It is still more singular, and as affecting as it is singular, that, owing to some error at the time, Dr. Prince's remains were carried down into the wrong tomb, and laid by the side of Dr. Barnard's. He did, literally, "follow him," not only "through death," but through the grave itself!

Great as was his taste for human science and philosophy, I speak with full conviction, drawn from a daily intimacy of many years, when I say that theology was the subject upon which he most loved to meditate, theological works were most frequently in his hands, and, as he advanced towards the end of life, I doubt not that among his most delightful anticipations of the heavenly state, was the disclosure there to be made, of all those truths, relating to eternity, the soul, and its author, about which his thoughts had been so habitually exercised.

Dr. Prince was a christian; for he had the spirit of Christ, which is a spirit of gentleness, tenderness and love. He loved God most devoutly; and he so loved man, that he seemed not to know how to cherish any other affection towards him. I believe him to have been incapable of hatred or enmity; and, as he was an enemy to no one, so I believe that he had not an enemy in the world. It appears that his benignant disposition was an object of particular remark at a very early period of his life. Mr. Barnard, in giving the Right Hand of Fellowship at his ordination, congratulated the people, in the plain simplicity of the times, that they had obtained for their pastor "a person of Mr. Prince's fine temper, and respectable abilities."

The circumstances connected with the history of Dr. Prince's improvements on the Lucernal microscope, which have been mentioned in another part of this article, present a beautiful illustration of his truly christian spirit. The fact that Mr. George Adams neglected to make him known as the author of those improvements, was freely remarked upon by others. One of his philosophical correspondents, in a letter dated London, March 3d, 1798, thus alludes to the subject: "I am rather surprised that the late Mr. Adams appears not to have made known the person to whom he was under so many and repeated obligations." But while such remarks fell from others, they were never known to pass the lips of Dr. Prince. The feelings they express were not permitted to enter his breast. It was a beautiful and most noble trait in his character, and one which was

impressed upon the notice of every observer, that he was incapable of jealousy and suspicion. So far from allowing himself to harbor unkind feelings towards Mr. Adams, or to indulge the idea that he had treated him with injustice, he rejoiced in his reputation, delighted to promote his prosperity, and when he heard of his death was most deeply and tenderly affected. The following extract from a letter addressed to Mrs. Adams on the occasion, will sufficiently show how superior he was to every feeling of jealousy or resentment. It is, indeed, expressive of the most affectionate friendship, and of the sincerest sympathy. The extract is particularly interesting, as it presents those elevated and devout associations which were always connected, in his mind, with his favorite philosophical pursuits.

"Salem, January 25th, 1796.

"*Dear Madam,*

"It is with sincere sorrow and regret that I hear of the death of Mr. Adams, and I heartily sympathize with you on that mournful event, an event which must have deeply wounded you, who was so intimately and tenderly connected with him. I ranked myself among his friends, and was gratified by the tokens which he gave me of his friendship, which I endeavored to return, by promoting his interest and reputation here among my friends in the line of his profession.

"But madam, though we lament his death, and the loss of his usefulness to society, yet it is a consolation that he has fallen in so good a cause: in promoting a knowledge of the works of nature among men, and leading their minds through these footsteps up to their Divine Author: in making the best and noblest use of Philosophy, that of expanding the idea of the Supreme Being in the minds of men, and impressing them with proper sentiments of piety towards him. This is the noblest pursuit of man here, and in this our friend hath spent himself: can we doubt that he is now reaping his reward in a superior state of knowledge and happiness, where the works of God can be more extensively contemplated; where the hidden things of nature which here perplex the philosopher, are more opened to the intelligent mind; and where God himself, the great, wise, and good author of the universe, gives a fuller display of his perfections, to make those who love him supremely happy.

"This, I doubt not, is the case with our departed friend, as I may judge from what I knew of his character, and the spirit of piety

which he has discovered in his lectures, the last of his works. To have put a finishing hand to these, and sent them forth into the world, previous to his death, must have given him great satisfaction, as he has left behind him the teachings of a philosopher, to instruct men in the noblest pursuits, and enable them to derive from these the most rational pleasures, in the contemplation of God as seen in his works. If this laborious task has been one means of shortening his days, we have to lament an effect which has produced a loss to us, though a gain to him. And it affords no small degree of satisfaction to me, that though dead, he yet speaketh in those writings in the language of a religious philosopher, who I must think, is the noblest of mankind. And in my imagination I conceive him participating in those sublime pleasures of heavenly devotion, to which he looked forward with such pious affection in some parts of his works. It is our part to follow him in death, as we cannot (if our selfishness would wish it) recall him to this imperfect life. Let us derive consolation from the hope of meeting him in a more perfect state—one better adapted to religious and philosophical improvement—the happiness of which will more than compensate us for all the troubles and disappointments of this life."

The christian piety of Dr. Prince was put to the severest test. Life had for him its full share of troubles, and the disease of which he finally died subjected him to the most excruciating sufferings, but no one ever heard a murmur or a complaint pass his lips. Neither the spirit of resignation nor the spirit of faith deserted him for a moment. The gospel shed its sweetest and divinest radiance upon his bed of suffering and death, and we may humbly hope that his spirit has been received to its rest and welcomed to the rewards of benevolence, integrity and truth.

And now, before I close the delineation, let me present to view the philosopher, the divine, and the christian, as these titles all became combined in his character in the evening of his days.

Old age, to those who reach it, is a sure test of character. To the man whose passions have been his masters, and whose mind has not been furnished to endure its trials, old age is but one protracted season of weariness, wretchedness, and woe. But to the true christian, and the real philosopher, it is, notwithstanding its infirmities, a most precious period. It affords an opportunity of rest and repose; the labors of life accomplished, the mind can calmly and quietly look back over the past, and if the past has been void of offence

and usefully spent, it can look forward and upward with peace, hope and joy. "Oh happy old age! he is unworthy to reach thee, who fears thee; he is unworthy to have reached thee, who complains of thee."*

The last years of Dr. Prince's life realized the brightest picture of a happy old age. By the kindness of his people he was released from labor and care,—a long respite was given him, after the day of toil was over, and before the summons came to depart. In the pursuits of philosophy and religion; in the peaceful and cherished society of a kindred spirit; in the company of his friends; in the exercise of amiable affections towards man, and of admiring adoration towards God, the glories of whose creation he was continually exploring; and in the enjoyment of enough of this world's goods to meet his wants, he quietly descended the lengthened vale of years. He had his trials, and at times they were severe indeed, but his patience and faith were sufficient to sustain him while they lasted, and when they had passed away, the very memory of them seemed to be obliterated by the pleasant engagements which, in cheerful conversation, in instructive books, in philosophical experiments, and in the employments of his workshop, were ever at hand. His faculties of body and mind remained sound and bright to the end, "his eye was not dim, nor his natural force abated;" and at last he came to his "grave in a full age, like as a shock of corn comes in the season thereof." In contemplating such an old age, we cannot but adopt the sentiment, although the conceit may be regarded as somewhat extravagant, which a quaint writer expressed on a similar occasion—"What a lovely spectacle! the angels of heaven fly to the windows of heaven to look upon such a spectacle."

It is highly honorable to the society, of which Dr. Prince was the pastor, that they continued to him an unabated support, although he was for a great length of time disabled from the discharge of his ministry, and for twelve years it was necessary to supply his place by the maintenance of a colleague. On his death bed he gave the most affecting testimony that this generous fidelity was duly appreciated. He bequeathed a most choice and valuable library, of four hundred and fifty three volumes, being nearly the whole of his theological books, for the perpetual use of his successors in the ministry of the First Church in Salem. The last act of his life, was to cause

* "O Felix Ætas! Indignus est ad te pervenire, qui te metuit. Indignus pervenisse, qui te accusat!"—*Petrarch.*

the following sentence to be inscribed, over his signature, upon the back of the catalogue of the books thus bequeathed.

"Sensible of the kindness of my people through my long ministry and life, I bequeath these books as a lasting memorial of my affectionate gratitude."

These words were dictated, and inscribed by the direction of Dr. Prince, on the morning of the 4th of June, in the presence of the writer of this notice. It was the last transaction in which he was ever engaged on earth, as he became speechless immediately afterwards.

During his whole sickness he exhibited that delightful serenity, which a purely philosophical spirit, resting on the faith, and filled with the hope of the gospel, will always enjoy and express. In his most excruciating pains, he never wavered for a moment in his resignation and acquiescence to the will of providence. The whole outward world, as well as the volume of scripture, had ever been radiant with divine wisdom and love, as he had spent his life in exploring them, and in death he lost not for a moment the blissful sight of his heavenly father's countenance. In his waking hours, his mind was warm with benevolent interest in his friends, and exalted into the highest exercises of pious faith and hope, and in his dreams the same trains of association seemed to occupy his spirit. During the last week of his life, he awoke from one of the few quiet slumbers vouchsafed to his suffering frame, and told the watcher by his bedside, that he had had a most delightful dream. "I dreamed," said he, "that I was in the New Jerusalem, and my church with me."

Such was the life and such the death of a christian philosopher, of whom America has reason to be proud, and to whom science owes a debt of gratitude, which she will ever be ready to acknowledge.

When we consider the obscurity of his early life, and then reflect upon the amount of his contributions to the cause of science, and upon the pure and elevated reputation secured to his name, through all coming ages, we cannot but recognize the stimulating encouragement held out to genius by his example; and in the serenity of temperament, the cheerful benignity of soul, the fortitude in trial, the resignation in suffering, the length of days, the happiness in old age, and the peace and joy on the bed of death, displayed by this venerable and devout philosopher, we see a specimen of the rewards bestowed upon all who are devoted to their cause, and imbued with their spirit, by SCIENCE and RELIGION.

REMARKS BY THE EDITOR.

It would be quite superfluous to attempt to add any thing to the preceding account of the late Dr. Prince, were it not that some circumstances fell under my own observation, which evince that his character sustained its interesting peculiarities, to a very late period of his life.

About one year before the death of Dr. Prince, (in May, 1835,) I was called to give a course of geological lectures in Salem, (Mass.) the town in which he resided. Dr. Prince was among my constant hearers, and also among the most attentive of a large and very intelligent audience. Although he had some acquaintance with minerals, geology was to him a new science. He had indeed been long accustomed to look beyond this planet, and to scrutinize other worlds; but he had not been habituated to study the structure of this earth. To him, then in his eighty fifth year, this was an experiment, like that made at an earlier period of life, by the celebrated Dr. Johnson, who, it is said, after he was seventy years old, learned a new language, for the sake of trying the soundness of his mind and memory.

Dr. Prince became deeply interested in the surprising developments of geology, and with the ardor of early life examined the drawings and the specimens, and attended to the experimental illustrations. Nor was he satisfied with the evidence of the lecture room. He took a party of gentlemen to see the beautiful jasper at Saugus, near Lynn, several miles from Salem, and being unwilling to relinquish any part of a more extensive geological excursion that was proposed, he passed over, by the beach that leads to Nahant, and with the writer of these remarks for an expounder of the surprising geological facts that abound in this ocean-barrier of rock, he followed the sea shore to Marblehead, and was particularly impressed by the magnificent dykes of trap that here invade the firm cliffs of sienite, and with the granite veins which rival those of Skye and Arran, (the classical ground of British geologists,) in their wonderful intrusions, tortuous ramifications, and abrupt displacements; while the broken veins are again recovered, at no great distance, and by their exact accordance in structure, color and form, evince that they were once connected, and were removed by convulsions from the position where they were first congealed after their igneous injection.

There was one enormous dyke in particular, upon the beach between Lynn and Salem, which excited so much interest in Dr.

Prince's mind, that he left his gig and climbed the rock, to examine, in place, this perfect wall of black basalt, cutting in two a cliff of sienite, and preserving its distinctness, even where both it and the broken rock were deeply worn and channeled by the powerful billows of that stormy coast, near which nothing exists as a breakwater to breast the waves and check the force of the ocean, impelled by tempests from the east.

From a circuit of twenty miles, the venerable philosopher returned, excited and gratified, while he manifested little more fatigue than the youngest of the party.

In his house he still exhibited not only the courtesies of hospitality, but the delightful resources of science: his library, his apparatus, and his experiments were open and accessible to his friends, and especially to strangers interested in liberal knowledge. The writer was, at several interviews, favored with those beautiful experiments so well described by Mr. Upham—the glories of the solar microscope, the splendid artificial volcano, the endless variety and both delicate and gorgeous beauty of the images of the improved Kaleidoscope, besides a rich train of experimental exhibition on other subjects, in which hours slid rapidly and most agreeably away.

In these kind and instructive recreations, Dr. Prince exhibited the activity and animation of early years—a perfect comprehension of his subject and a high degree of enjoyment in making others happy. It was surprising to observe the great amount of intellectual and physical *materiel* which he had accumulated within his domestic confines. In his study, although not small, you literally threaded your way through alleys and vistas of books, instruments and specimens, and not an inch of room was lost in the skillful disposition of this philosophical panoply.

In commemorating this most venerable and most interesting sage, it may not be inappropriate to mention, that many years since, when employed among the philosophical artists of London in obtaining various and valuable instruments, I found that Dr. Prince's name and his discoveries and improvements, were well known and highly appreciated by them, and an eminent artist in that great capital could present me nothing better in pneumatics than the air pump, and in optics than the lucernal and solar microscopes of Dr. Prince. The collection of instruments obtained on that occasion, was after their arrival, reviewed by Dr. Prince in Yale College, and having met his decided and warm approbation, this judgment when reported

to the London artist, was pronounced by him to be the highest encomium that could be bestowed.* Dr. Prince, from the love of science and an ardent zeal to promote its diffusion, used to keep on hand collections of some of the most important philosophical instruments, for the supply of colleges and other higher seminaries, while the trifling commission which he charged on the original bills was hardly sufficient to save him from loss. At a very short notice, he displayed for me a very complete pneumatic apparatus which would have been a treasure to any college. In this particular, as well as in the *tout ensemble* of his character, his place will hardly be filled again; and he himself enjoyed the satisfaction of seeing that the exigencies of science in this country, could now be much better supplied than when he was its sole pioneer in the eastern, and almost in the United States.

In all future periods of our advancement in the physical sciences, his name will be remembered with honor, *clarum et venerabile nomen.*

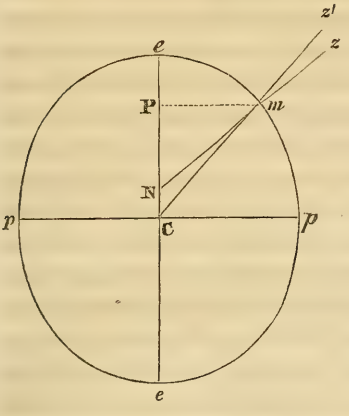
Art. II.—*On the Length of a Degree of the Terrestrial Meridian—Oblateness and axes of the Earth—Comparative oblateness of the Planets—Reduction of Latitude—Radius of the Earth—and Length of a Degree of Parallels of Latitude; with appropriate Tables*; by Tho. Jefferson Cram, Principal Assistant to Prof. of Nat. and Exp. Philos. U. S. Mil. Acad., West Point.

Length of a Degree of the Terrestrial Meridian.

1. By direct admeasurement, and by other observations, it has been conclusively shown, that the curvatures of the terrestrial meridians diminish, as we recede from the equator in going towards the poles; whence the inference, that the earth resembles in figure more nearly a spheroid than any other mathematical body. The spheroid is the solid which would be generated, by revolving an ellipse around its minor axis; and it is to such a solid, that we shall assimilate the figure of the earth in what follows.

* The same artist informed me, that he was in possession of philosophical instruments, constructed by Dr. Prince's own hands, which did him equal credit, as a workman and as a philosopher, and that they were among the articles upon which he set great value. They came to him, (R. Banks, 441 Strand,) from the collection of the late Mr. Adams. It is my impression that among them was a lucernal microscope.

2. Let the annexed ellipse represent the generatrix which being revolved round its minor-axis pp, would generate the earth: during



the revolution the extremities ee, of the major axis, generate the circumference of the terrestrial equator; and any point m, of the ellipse, generates the circumference of a parallel of latitude: The axes ee, and pp, would represent respectively, the equatorial and polar diameters of the earth. Let the former of these axes be denoted in length by $2a$, and the latter by $2b$; and the abscissa CP, of the point m, by x; and the corresponding ordinate Pm, by y. The angle eNm, made by the normal Nz, with the plane of the equator, is called the latitude of the place m; and we shall represent this latitude by ψ. The oblateness of the earth is measured by the ratio $\frac{a-b}{a}$, which we will put equal to α; and then we shall have $b=(1-\alpha)a$, which being combined with the equation of the ellipse as found in treatises on conic sections, will give $y^2=(1-\alpha)^2(a^2-x^2)$, (1), for the equation of our generatrix.

3. From the properties of the ellipse, we know that the subnormal is expressed by $\frac{b^2}{a^2}x$; hence, by substituting the value of b in terms of a and α, as above expressed, we have $\text{PN}=(1-\alpha)^2x$; and since tang. $\psi=\frac{y}{\text{PN}}$, by replacing PN by its value just found, and y by its value as given by (1) we shall have tang. $\psi=\sqrt{\frac{a^2-x^2}{(1-\alpha)^2x^2}}$. From the last expression we immediately deduce the equation,

$$x^2=\frac{a^2}{1+\text{tang.}^2\psi(1-\alpha)^2}. \quad (2).$$

4. Every terrestrial meridian being an ellipse equal in all respects to that which, by its revolution, generates the spheroid to which we have assimilated the figure of the earth, it follows that the law of the curvature of this ellipse, will be the same as that which governs the curvature of any meridian of the earth. Of all the circles that

can be drawn tangent at the same point of any curve, that which coincides with the curve for the greatest extent, is called the osculatory circle of the curve; and the radius of this circle is called the radius of curvature of the curve. By the radius of curvature we may judge of the degree of curvature of the curve at its different points; for the curvature at the point of contact being the same as that of the osculatory circle, and the curvature of a circle being greater as its radius is less, and vice versa, it follows, that the curvature of a curve is greater as its radius of curvature is less, and vice versa. In the ellipse the curvature is a maximum, and the radius of curvature a minimum, at the extremities of the major-axis: in going from these extremities towards the flattened parts of the curve, the curvature decreases, and the radius of curvature increases, until we arrive at the extremities of the minor axis, where the curvature becomes a minimum and the radius of curvature a maximum. So, in going on a meridian towards the poles, the radius of curvature, being least at the equator, increases from one latitude to another, until we arrive at the poles, where the curvature is the least, and the radius of curvature the greatest.

5. For the purpose of expressing the forementioned circumstances attending the curvature of a terrestrial meridian in a formula, we take the general formula $\gamma = \dfrac{\left(1+\left(\dfrac{dy}{dx}\right)^2\right)^{\frac{3}{2}}}{\dfrac{d^2y}{dx^2}}$, for the radius of curvature of any curve, (See Diff. Cal.), and substitute in it the value of $\left(\dfrac{dy^2}{dx}\right)$ and of $\dfrac{d^2y}{dx^2}$, drawn from equation (1). By the rules of differentiation, equation (1) gives $\left(\dfrac{dy}{dx}\right)^2 = \dfrac{x^2(1-\alpha)^2}{a^2-x^2}$, and $\dfrac{d^2y}{dx^2} = \dfrac{(1-\alpha)^4a^2}{[(1-\alpha)^2(a^2-x^2)]^{\frac{3}{2}}}$, which values, together with the equation (2) and the trigonometrical relation between the tangent and sine, will give us $\gamma = \dfrac{a(1-\alpha)^2}{(1-\sin.^2\psi[1-(1-\alpha)^2])^{\frac{3}{2}}}$, (3), for the radius of curvature of a terrestrial meridian at any point whose latitude ψ, is known.

6. By making in formula (3) $\psi = 0°$, we shall obtain $a(1-\alpha)^2$ for the radius of curvature of the meridian where it crosses the

equator, and by making $\psi=90^\circ$ we shall obtain $\frac{a}{1-\alpha}$ for the radius of curvature of the meridian at the poles: and as α is less than unity, it follows, that the former radius of curvature is less, and that the latter is greater, than the semi-equatorial diameter; hence, the curvature is greater at the equator and less at the poles, than at any other point on the meridian—which is in accordance with what is said in 4.

7. Having found the radius of curvature (3) for any point of the meridian, we can construct the osculatory circle at the same point; and as this circle will be sensibly confounded with the meridian itself for some extent, the length of a degree of the circle, will be sensibly equal to the length of the degree of the meridian, at the point of contact. It is upon this principle, that we shall obtain the length of a degree whose *middle point* is at any place *m*, in terms of the measure of the earth's oblateness and equatorial diameter; thus—

8. Denoting by L, the length of a degree of a terrestrial meridian, and by π, the ratio of a circumference to its diameter, we shall have the proportion $L : 2\pi\gamma :: 1^\circ : 360^\circ$; whence, by substituting the value of the radius of curvature (3) we derive $L=$

$$\frac{\frac{\pi}{190}\times a(1-\alpha)^2}{(1-\sin.^2\psi[1-(1-\alpha)^2])^{\frac{3}{2}}},\quad (4),$$

for the formula by which the length of a degree, having its middle point at a place whose latitude ψ is known, may be estimated: for examples, making $\psi=0^\circ$ and $\psi=90^\circ$ in the formula, we shall obtain $\frac{\pi}{180}\times a(1-\alpha)^2$ and $\frac{\pi}{180}\times\frac{a}{(1-\alpha)^2}$ respectively, for the lengths of the degrees, one at the equator, and the other at the pole; and as α is less than unity, we perceive that the length of the former is greater than the length of the latter: moreover, $\frac{\pi}{180}\times a$, which expresses the length of a degree of the equator, being greater than $\frac{\pi}{180}\times a(1-\alpha)^2$, we infer, that the length of the degree of the meridian, where it crosses the equator, is less than the length of a degree of the equator itself—a fact which might have been anticipated, from the circumstance of

the meridian, where it cuts the equator, having a greater degree of curvature than the equator; which is demonstrated by a comparison of the radii of curvature of the meridian and equator at the points where they intersect each other.

9. Expanding the radical part of formula (4) into a series we shall obtain $1+\frac{1.3}{1.2}(2\alpha-\alpha^2)\sin.^2\psi-\frac{1.3.5}{1.2.2}(2\alpha-\alpha^2)^2\sin.^4\psi+\&c.$ Now if α be an exceedingly small fraction, its powers which are higher than the first, may be neglected, as being too small to affect materially the first two terms of the series; and if we denote by L′ the length of the degree of the meridian of the equator (see 8), formula (4) may be written under the form, $L'=L'+3\alpha\sin.^2\psi L'$, (4′). The first term of the second member of this formula, being the length of the degree of the meridian at the equator, the second term is the increment which the length of that degree receives to make up the value of L in going from the equator towards the poles; and hence the theorem as given by Laplace in his Mécanique Céleste; and which we shall enunciate by translating his own words. "The increment of the degrees of the meridian in proceeding from the equator to the poles, is therefore proportional to the square of the sine of latitude."

10. It will now be proper to explain the methods by which the values of α and a, have been determined: Four distinct methods have been used for the purpose of solving the problem: First, by adverting to formula (4) it will be perceived that the second member contains, besides the sine of latitude, the quantities α and a; and therefore, if the lengths of two different degrees be determined by direct geodetical admeasurement, and the latitudes of their middle points be determined by observation, by placing each of the measured lengths, and the observed latitudes of the degrees, in formula (4), we can determine α and a, since we should have two equations with only two unknown quantities: We shall not here describe the geodetical operations by which the degrees have been measured, nor the method of determining the latitudes of their middle points; but will exhibit in a tabular form the results of such of these operations as are deemed to be the most correct.

Table of measured lengths of portions of Terrestrial Meridians.

Country.	Latitude ψ of middle point of measured degree.	Mean length of a measured degree in English fathoms.
Peru,	1° 31′ 00.34″ North.	60467.7 No. 1.
India,	13° 06′ 31.00″ "	60492.8 " 2.
France,	44° 51′ 02.65″ "	60755.7 " 3.
England,	52° 02′ 17.58″ "	60824.1 " 4.
Sweden,	66° 20′ 09.91″ "	60954.8 " 5.

Substituting the lengths of the degrees which are given, and for convenience numbered, in the table, for L and the corresponding latitudes for ψ, in formula (4), and proceeding agreeably to the manner just before explained, we obtain ten values for each of the quantities α and a. The measured degrees which are numbered 1 and 2, give $\alpha=\frac{1}{366}$, $a=3958.554$ miles: 1 and 3 give $\alpha=\frac{1}{314}$, $a=3962.184$ m.: 1 and 4 give $\alpha=\frac{1}{317}$, $a=3961.954$ m.: 1 and 5 give $\alpha=\frac{1}{314}$, $a=3962.17$ m.: 2 and 3 give $\alpha=\frac{1}{308.6}$, $a=3962.287$ m.: 2 and 4 give $\alpha=\frac{1}{313}$, $a=3961.925$ m.: 2 and 5 give $\alpha=\frac{1}{311}$, $a=3962.111$ m.: 3 and 4 give $\alpha=\frac{1}{332}$, $a=3961.327$ m.: 3 and 5 give $\alpha=\frac{1}{314}$, $a=3962.176$: 4 and 5 give $\alpha=\frac{1}{305}$, $a=3961.977$ m. The discrepancies in the different values are doubtless owing to unavoidable errors, arising from the local irregularities of those portions of the earth's surface where the degrees were measured. But if we take the mean of all the values, we shall, in all probability, diminish the effect of these errors. The means are, $\frac{1}{318}$ for the measure of the oblateness, and 3961.6667 English miles, for the equatorial radius of the earth. There is a method of combining the quantities in the table, to determine α, invented by Lagrange, which is called 'The method of the least squares,' and which consists in making the sum of the squares of the errors a minimum when compared to each of the unknown quantities of the problem. Doctor Bowditch has improved this method, and with the five measured degrees in the table, has obtained $\alpha=\frac{1}{312}$. There is also another method due to

Boscovich, which is exceedingly well adapted to the solution of the problem under consideration, and which is founded upon the conditions: 1. That the sum of the errors committed in the measures of the whole arcs ought to be zero. 2. That the sum of all these errors taken positively, ought to be a minimum. Upon these conditions the measure of the oblateness of the earth is found by Doctor Bowditch, using the same degrees as before, to be equal to $\frac{1}{310}$: it should be remarked, however, that in both cases Dr. Bowditch used formula (4′) instead of formula (4.)

11. The second process employed by geometricians for determining the measure of the earth's oblateness, consists in observing the length of a pendulum oscillating in a given time at different latitudes, and then calculating the corresponding intensities of gravity. Since the length of such a pendulum is directly proportional to the intensity of gravity, it follows that the variations of the length of the pendulum obey the same law as the variation in the intensity of gravity; and therefore if the earth were of a spheroidal form of a sensible degree of oblateness, the variations in the intensity of its gravity, arising from difference of distance from the different points of its surface to its centre, would produce sensible variations, proportionate to the degree of oblateness, in the length of a pendulum oscillating in a given time. The intensity of gravity, being calculated with great precision from the observed length of the pendulum, is found to increase in going from the equator towards the poles; and the excess of its intensity at any latitude above its intensity at the equator, is thus found, as it were by observation, to obey exactly the same law that results from calculation founded upon the hypotheses of a spheroidal form for the earth, and of the intensity of its gravity being inversely as the square of the distance from its centre; and when allowance is made in the calculation for the effect of the centrifugal force arising from the earth's rotation, the absolute amount of the calculated variations in the intensity of gravity, are found to be verified in a remarkable degree, by the amount of variations as deduced from the observed lengths of the pendulum. The results of the researches founded upon the method now under consideration, for determining α, show that the inequalities of the surface of the terrestrial spheroid, have much less influence upon the variations of the length of the pendulum, than upon the variations of the degrees of the meridians; and therefore it may be inferred, that the value

of α, resulting from this process, is less liable to inaccuracy than the value resulting from the measured degrees of the meridian. Dr. Bowditch has collected and recorded about fifty observed lengths of the seconds pendulum; and, combining the best forty four of them upon the principle of the least squares, has obtained $\alpha = \frac{1}{297}$; and combining the same number, according to the method of Boscovich, has found $\alpha = \frac{1}{301}$, using a formula for the length of the pendulum, in which the second and higher powers of α are neglected.

12. The third method for determining the measure of the earth's oblateness, is less direct than either of those before mentioned, but is one of the most striking results, that the application of analysis to the great law of universal gravitation, has produced; and is worthy of an important rank in the history of the progress and powers of the human mind. This method consists in recognizing among the numerous inequalities of the moon's motion, those which depend upon the non-sphericity of the earth; and in comparing their values, as given by observations, with those resulting from calculations founded upon the hypothesis of a spheroidal form for the earth, and that the protuberance at the equator would sensibly affect the moon's motion. Laplace, to whom the idea of the method now being considered, is due, found, by using the observations of Burg, upon the irregularities of the moon's motion, that the oblateness of the earth, resulting from these phenomena, was $\frac{1}{305.05}$. Doubtless this method of determining α is susceptible of greater accuracy than any other which is founded upon observation, since the other two methods involve observations peculiarly liable to be affected by local irregularities and causes necessarily encountered on the earth's surface; whilst on the contrary, these same irregularities and local causes, owing to the distance of the moon, would not sensibly disturb the circumstances of the moon's motion, which depend upon the oblateness of the earth.

13. Finally, the phenomena of nutation and precession of the equinoxes, furnish valuable ideas upon the figure of the earth. These phenomena do not, it is true, give the absolute value of the measure of its oblateness, but they make known two limits between which this measure is contained, and which are found to be $\frac{1}{279}$ and $\frac{1}{578}$.

14. After what we have said of the superiority of the method founded upon lunar observations, it might be expected that we should adopt $\frac{1}{305.05}$ for α; but we are not assured that a sufficient number of observations have yet been applied, to entitle this value to be received; besides, we are deterred by the opinion of Dr. Bowditch, than whose opinion none commands greater deference from all who are acquainted with the splendid monument, which the American mathematician has recently erected to his own genius, in his translation of the Mécanique Céleste; a translation for which one ought to be the more grateful, since, with the help of the translator's numerous addenda, it is comparatively easy to understand the modus operandi of treating the great questions of physical science embodied in the original work of the immortal Laplace. From an elaborate examination of the figure of the earth, Dr. Bowditch concludes that $\frac{1}{301}$ measures the oblateness more nearly than any other fraction, and that the corresponding value of the semi-equatorial diameter is 3963 miles, and the semi-polar diameter 3950 miles very nearly. These values for α and a, being placed in formula (4) will give us $L=\frac{68.70859375 \text{ miles}}{1-\sin.^2\psi\times 0.006633256}$ (5). From this we have calculated the following table, in which columns A contain the latitudes, and columns B the lengths of the corresponding degrees, having their middle points at the latitudes given in the table; the latitudes being expressed in degrees, and the values of L in English miles.

Table of the Length of the Degrees of the Terrestrial Meridian.

A	B	A	B	A	B	A	B	A	B	A	B
°	miles.	°	miles.	°	miles.	°	miles.	°	miles.	°	miles.
0	68.708594	15	68.754413	30	68.879873	45	69.051873	60	69.224539	75	69.351413
1	68.708825	16	68.760571	31	68.890333	46	69.063873	61	69.234905	76	69.357302
2	68.709437	17	68.767079	32	68.900952	47	69.075889	62	69.245063	77	69.362809
3	68.710484	18	68.773936	33	68.911889	48	69.087905	63	69.254951	78	69.367936
4	68.711682	19	68.781143	34	68.915936	49	69.098250	64	69.263220	79	69.372651
5	68.713809	20	68.788651	35	68.934127	50	69.111968	65	69.272619	80	69.377000
6	68.716079	21	68.796492	36	68.945492	51	69.123619	66	69.284145	81	69.380936
7	68.718762	22	68.804667	37	68.956968	52	59.135317	67	69.291984	82	69.384492
8	68.721828	23	68.813127	38	68.968556	53	69.146968	68	69.300556	83	69.387635
9	68.725344	24	68.821841	39	68.980238	54	69.158492	69	69.308774	84	69.390371
10	68.729254	25	68.830873	40	68.992048	55	69.169889	70	69.316492	85	69.392683
11	68.733508	26	68.840030	41	69.003921	56	69.181174	71	69.324349	86	69.394556
12	68.738175	27	68.849762	42	69.015841	57	69.192032	72	69.331629	87	69.396048
13	68.743206	28	68.859079	43	69.019492	58	69.203206	73	69.338587	88	69.396889
14	68.748651	29	68.868762	44	69.039825	59	69.213984	74	69.345177	89	69.397746
15	68.754413	30	68.879873	45	69.051873	60	69.224539	75	69.351413	90	69.397594

If the length of a degree be required, whose middle point falls between any two consecutive latitudes expressed in the table, it would be sufficiently accurate to proceed as follows: Suppose we wish the length of the degree whose middle point is at the latitude 41° 24′ 10″—we perceive from the table, that the difference between L answering to 42°, and L answering to 41° of latitude, is 00.011920 miles; then we say, as 1 is to 00.011920, so is 0° 24′ 10″ to a fourth term $\left(\frac{24'10'' \times .01192}{1^\circ}\right)$, which being added to the tabular length of the degree whose middle point corresponds to the latitude 41°, will give the length of the degree sought. This method, of course is but an approximation; but if the utmost accuracy be desired, we should place 41° 24′ 10″ for ψ in formula (5), and deduce from it the corresponding value for L.

Reduction of Latitude.

1. It is evident that the vertical and radius at every point on the earth's surface will make an angle with each other, excepting at the equator and the poles. This angle is called the *reduction of latitude;* and for the purpose of determining its value, let Cz' be the radius of the earth produced through any place m; and designate by δ the required angle zmz' or its equal CmN; and the angle PCm by C. From the triangle PNm, right-angled at P, we have $\text{tang.}\,\psi = \frac{\text{P}m}{\text{PN}} = \frac{a^2}{b^2} \times \frac{y}{x}$, since PN is equal to $\frac{b^2}{a^2}\,x$. We also have $\text{tang.}\,\text{C} = \frac{y}{x}$, whence, by combining this with the value of tang. ψ, we obtain $\text{tang.}\,\text{C} = \frac{b^2}{a^2} \times \text{tang.}\,\psi$; but $\delta = \psi - \text{C}$, therefore, we shall have

$$\text{tang.}\,\delta = \text{tang.}\,(\psi - \text{C}) = \frac{\text{tang.}\,\psi - \text{tang.}\,\text{C}}{1 + \text{tang.}\,\psi \times \text{tang.}\,\text{C}} = \frac{(a^2 - b^2)\,\text{tang.}\,\psi}{a^2 + b^2\,\text{tang.}^2\,\psi},$$

which, by substituting in it $a(1 - \alpha)$ for b, is reduced to $\text{tang.}\,\delta = \frac{[1-(1-\alpha)^2]\,\text{tang.}\,\psi}{1+(1-\alpha)^2\,\text{tang.}^2\,\psi}$, (6), which is the formula for estimating the value of δ, at any given latitude ψ.

2. In proceeding from the equator towards either pole, and vice versa, the angle δ increases to a certain value depending upon the oblateness, and then begins to decrease; hence, at that certain latitude δ has a true maximum value; and as δ is a maximum when its

tangent is a maximum in the present case, therefore, to find the latitude of the place where the reduction of latitude is the greatest, we have only to put the first differential coefficient of tang. δ equal to zero, and the resulting value for tang. ψ, will give the latitude sought. Thus, formula (6) being differentiated, and the first differential coefficient being put equal to zero, we obtain $1-(1-\alpha)^2 \times \text{tang.}^2\psi=0$, whence $\text{tang.}\psi=\frac{1}{1-\alpha}=\frac{a}{b}$; therefore the place where the reduction of latitude is a maximum, has the tang. of its latitude equal to the ratio of the equatorial to the polar axis. It is worthy of remark too, that when δ is a maximum, the angle eCm, which is called the reduced latitude, has its tang. equal to $\frac{b}{a}$, as will readily appear by substituting the value of the tang. of the maximum value of δ, in the relation between tang. C and tang. ψ, as found in 1. It follows therefore that the reduced latitude, when a maximum, has the value of its tang. expressed by the ratio of the polar to the equatorial axis.

3. It is evident that all which has been said relative to the angle made by the normal and radius at any point on the earth, will apply with equal force to either of the other oblate planets; therefore formula (6) may be applied to either of these planets by substituting the proper value for α; now, for Earth $\alpha=\frac{1}{301}$; for Mars $\alpha=\frac{83}{1355}$; for Jupiter $\alpha=\frac{728}{10{,}000}$, and for Saturn $\alpha=\frac{3}{35}$. These values being successively placed in the maximum value of tang. δ, we derive the numbers in column 2. of the following table; and these maxima values being substituted, together with the corresponding values of α in formula (6), will give the numbers recorded in column 3.

Table of the maxima values of the Reduction of Latitude for the different planets.

1. Names of Planets.	2. Maximum value of δ.	3. Latitude where δ is a maximum.
Earth, -	0° 11′ 26.34204″	45° 05′ 16.80315″
Mars, -	3° 37′ 09.52994″	46° 48′ 34.71429″
Jupiter, -	4° 19′ 36.50257″	47° 09′ 47.92381″
Saturn, -	5° 07′ 39.14768″	47° 33′ 49.5333″

The results expressed in this table give a very good idea of the comparative degrees of flatness of the oblate planets, for the more the

planet is flattened, the greater will be the deviation between the normal and radius, at the place where the reduction of latitude is a maximum.

4. The number $\frac{1}{301}$, the measure of the earth's oblateness, being put for α in formula (6), we shall obtain

$\text{tang.}\,\delta = \dfrac{\text{tang.}\,\psi}{150.750 + 149.750 \times \text{tang.}^2\psi}$; from which we have constructed the following table, in which columns A contain the latitudes differing by 1°, and columns B the corresponding values of the reduction of latitude for the earth.

Table of Reduction of Latitude—the oblateness being $\frac{1}{301}$.

A	B	A	B	A	B	A	B	A	B	A	B
°	′ ″	°	′ ″	°	′ ″	°	′ ″	°	′ ″	°	′ ″
1	0 23.378	16	6 02.737	31	10 05.113	46	11 26.064	61	9 43.132	76	5 23.198
2	0 47.725	17	6 22.776	32	10 16.037	47	11 24.889	62	9 30.116	77	5 01.803
3	1 11 514	18	6 42.375	33	10 26.199	48	11 22.944	63	9 16.201	78	4 40.037
4	1 35.216	19	7 01.488	34	10 35.630	49	11 20.038	64	9 02.004	79	4 17.868
5	1 58.804	20	7 20.090	35	10 44.274	50	11 16.367	65	8 46.943	80	3 55.501
6	2 22.249	21	7 38.161	36	10 52.138	51	11 11.868	66	8 31.236	81	3 32.785
7	2 45.523	22	7 55.678	37	10 59.204	52	11 06.551	67	8 14.901	82	3 09.806
8	3 08.596	23	8 12.619	38	11 05.478	53	11 00.419	68	7 57.961	83	2 46.595
9	3 31.443	24	8 28.964	39	11 10.939	54	10 53.479	69	7 40.433	84	2 23.178
10	3 54.033	25	8 44.686	40	11 15.585	55	10 45.743	70	7 22 339	85	1 59.585
11	4 16.341	26	8 59.788	41	11 19.408	56	10 37.216	71	7 03.703	86	1 35.848
12	4 38.341	27	9 14.228	42	11 22.405	57	10 27.910	72	6 44.548	87	1 11.987
13	5 00.003	28	9 27.997	43	11 24.572	58	10 17.825	73	6 24.894	88	0 48.041
14	5 21.304	29	9 41.078	44	11 25.905	59	10 07.006	74	6 04.769	89	0 24.045
15	5 42.216	30	9 53.500	45	11 26.403	60	9 55.434	75	5 44.194	90	0 00.000

If the value of δ be required for a latitude between any two consecutive latitudes of the table, it will be sufficiently accurate for most purposes, to determine it by an interpolation as follows: Let it be required to determine by means of the table, the reduction of latitude at a place whose latitude is 41° 24′ 36″. We perceive from the table, that the *difference* between the values of δ, corresponding to latitudes 41° and 42°, is equal to 2.997″; we then say, as 1° is to 2.997″, so is 24′ 36″ to a fourth term, which is equal to $\dfrac{2.997'' \times 24'\,36''}{1^\circ} = \dfrac{2.997'' \times 1476''}{3600''} = 1.229''$, which, being *added* to the value of δ, corresponding to the latitude 41°, will give the value of the required reduction of latitude; if the value of δ had been required for a latitude greater than that at which δ is a maximum, the term found by interpolation should have been *subtracted*. When the utmost degree of accuracy is required, then we must resort to the use of the formula from which the table is constructed, and deduce

at once the value of δ, corresponding to a latitude not expressed in column A of the table.

Radius of the Earth.

1. Knowing the Reduction of Latitude, we can readily obtain the Radius of the Earth, corresponding to any given latitude $\downarrow$. Thus— let the radius Cm be designated by ρ; and we shall have, from the triangle PCm, $y^2=\rho^2 \sin.^2 \mathrm{PC}m$, and $x^2=\rho^2 \cos.^2 \mathrm{PC}m$; but $\mathrm{PC}m = \downarrow - \delta$, hence, $y^2=\rho^2 \sin.^2(\downarrow-\delta)$, and $x^2=\rho^2\cos.^2(\downarrow-\delta)=\rho^2 \times [1-\sin.^2(\downarrow-\delta)]$; these values of y^2 and x^2 being placed in equation (1) will give the relation
$\rho^2\sin.^2(\downarrow-\delta)=(1-\alpha)^2(a^2-\rho^2[1-\sin.^2(\downarrow-\delta)])$, whence we obtain $\rho=\dfrac{a}{\left(1+\dfrac{1-(1-\alpha)^2}{(1-\alpha)^2}\times\sin.^2(\downarrow-\delta)\right)^{\frac{1}{2}}}$ which, by substituting $\dfrac{1}{301}$ for α, reduces to $\rho=\dfrac{a}{1+0.006678\sin.^2(\downarrow-\delta)}$. (7).

2. Formula (7) can be easily reduced to numbers, for we shall have the value of δ, given by the table for the reduction of latitude, when $\downarrow$ is assigned: Regarding a, the earth's equatorial radius, unity, we have calculated from formula (7) the table below, in which columns A contain the given latitudes differing by 1°, and columns B, the corresponding values of the terrestrial radius.

Values of the Earth's radius—the equatorial radius being 1.000000.

A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
0°	1.000000	10°	0.999900	20°	0.999614	30°	0.999175	40°	0.998634	50°	0.998057	60°	0.997513	70°	0.997069	80°	0.996779
1	0.999999	11	0.999880	21	0.999577	31	0.999124	41	0.998577	51	0.998000	61	0.997464	71	0.997032	81	0.996760
2	0.999996	12	0.999857	22	0.999537	32	0.999073	42	0.998519	52	0.997944	62	0.997415	72	0.996997	82	0.996742
3	0.999992	13	0.999833	23	0.999496	33	0.999020	43	0.998462	53	0.997888	63	0.997367	73	0.996964	83	0.996728
4	0.999983	14	0.999807	24	0.999454	34	0.998967	44	0.998404	54	0.997832	64	0.997320	74	0.996932	84	0.996714
5	0.999975	15	0.999780	25	0.999411	35	0.998913	45	0.998346	55	8.997777	65	0.997275	75	0.996902	85	0.996703
6	0.999964	16	0.999750	26	0.999366	36	0.998859	46	0.998288	56	0.997722	66	0.997231	76	0.996874	86	0 996694
7	0.999954	17	0.999718	27	0 999319	37	0.998803	47	0.998230	57	0.997669	67	0.997189	77	0.996848	87	0.996687
8	0.999937	18	0.999685	28	0.999272	38	0.998747	48	0.998172	58	0.997616	68	0.997147	78	0.996825	88	0.996679
9	0.999919	19	0.999650	29	0.999224	39	0.998691	49	0.998114	59	0.997564	69	0.997107	79	0.996800	89	0.996678
10	0.999900	20	0.999614	30	0.999175	40	0.998634	50	0.998057	60	0.997513	70	0.997069	80	0.996779	90	0.996677

When it is required to find the length of the radius, by means of the table, for a place whose latitude falls between any two consecutive ones of the table, we proceed in a manner entirely similar to that explained for the reduction of latitude.

3. Since a is equal to 3963 English miles, we have only to multiply this number by the decimal given by the table, and the product will be the number of miles in the terrestrial radius, at the place whose latitude is in column A, on the left of the decimal used.

Length of a Degree of a Parallel of Latitude.

1. Knowing the reduction of latitude (formula (6)) and the terrestrial radius (formula (7)) corresponding to any place, the length of a degree of the parallel of latitude at the same place, may be readily found as follows: The parallel being the circle generated by the point m, during the revolution of the generatrix, will have its radius equal to x: now we have already shown, that $x=\rho\cos.(\psi-\delta)$; and if we designate by l, the length of the degree sought, we shall have $l=\frac{\pi}{180}\rho\cos.(\psi-\delta)$; if in this we place the value of ρ given by formula (7), we shall find

$$l=3963 \text{ miles}\times\frac{\pi}{180}\times\frac{\cos.(\psi-\delta)}{[1+.006678\sin.^2(\psi-\delta)]^{\frac{1}{2}}}. \quad (8.)$$

2. Having first found δ, by formula (6), and then substituting the value of δ thus found, in formula (8) we shall at once reduce the corresponding value of l; and it is in this manner that we have constructed the following table, in which columns A exhibit the latitudes differing by 1°, and columns B the corresponding length of a degree of the parallel of latitude.

Lengths of Degrees of Parallels of Latitude.

A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
°	Miles.	°	Miles.	°	Miles.	°	Miles.	°	Miles.	°	Miles.	°	Miles.	°	Miles.	°	Miles.
0	69.167412	10	68.1234	20	65.0213	30	59.9504	40	53.0580	50	44.5466	60	34.6700	70	23.7261	80	12.0776
1	69.1669	11	67.9189	21	64.6008	31	59.3402	41	52.2759	51	43.6160	61	33.6184	71	22.5859	81	10.8554
2	69.1256	12	67.6656	22	64.1608	32	58.7137	42	51.4778	52	42.6715	62	32.5564	72	21.4385	82	9.6578
3	69.0733	13	67.4060	23	63.7012	33	58.0658	43	50.6640	53	41.7142	63	31.4842	73	20.2842	83	8.4572
4	69.0100	14	67.1258	24	63.2237	34	57.4020	44	49.8347	54	40.7440	64	30.4026	74	19.1239	84	7.2541
5	68.9060	15	66.8254	25	62.7242	35	56.7205	45	48.9900	55	39.7615	65	29 3114	75	17.9574	85	6.0484
6	68.7910	16	66.5048	26	62.2069	36	56.0218	46	48.1304	56	38.7663	66	28.2110	76	16.7855	86	4.8409
7	68.6554	17	66.1639	27	61.5290	37	55.3059	47	47.2560	57	37.6726	67	27.1022	77	15.6086	87	3.6320
8	68.4987	18	65.8029	28	61.1158	38	54.5732	48	46.3671	58	36.7410	68	25.9848	78	14.4266	88	2.4219
9	68.3214	19	65.4220	29	60.5424	39	53.8239	49	45.4639	59	35.6535	69	24.8592	79	13.2402	89	1.2111
10	68.1234	20	65.0213	30	59.9504	40	53.0580	50	44.5466	60	34.6700	70	23.7261	80	12.0776	90	0.000000

Should the parallel pass through a place whose latitude falls between two consecutive ones given in the table, the length of the degree may be approximated to, with a sufficient degree of accuracy, by a method entirely similar to that explained in the subject of the length of a degree of the meridian; but if the utmost accuracy be required, then we must deduce the length of the degree from the formula.

Art. III.—*On Definitions;* by Rev. D. Wilkie, of Quebec.

No. IV.

Definitions in Grammar.—There are two sorts of definitions in grammar; one peculiar to the science properly so called, and another practiced in all articulate languages, and which it is the chief object of grammar to reduce to precision. The former comprehends the definitions of terms introduced by the grammarian, such as noun, verb, tense, number, and all the other grammatical terms and phrases which are brought into use, when men begin to indulge their speculations on the subject of language, and to lay down rules for its regulation and for its improvement. The other sort of definitions, comprehends those which are employed in all languages, and which are introduced by custom alone, varied and altered from time to time by the same cause. Of this kind are the distinctions of the singular and plural numbers, of present, past and future times, of the agent and subject of an action, with many other distinctions which the necessities of human intercourse require, and which every different language has its own method of supplying.

It is on these later distinctions, that I intend at present to make some observations. And first, I observe, that though not given out as such, they are in their nature definitions.* Whenever custom has introduced the practice of using one form of a word to denote the singular or a single object, and another to denote the plural or any indefinite number of objects, this practice amounts to a virtual and tacit definition. One word, or one form of the word, is then ever after appropriated to signify one object, and another word, or another form of the same word, is appropriated to signify more objects than one. It is immaterial whether the alteration is made on the end of the words, as is more common, or on the beginning, or on the middle of it; or by prefixing one or annexing another. In whatever of these modes the alteration is made, the purpose is the same, namely, to mark a useful distinction, and to shorten discourse by expressing in one letter or syllable, or at least one word, what would otherwise require a considerable circumlocution.

The same observation is true of all the other distinctions and changes upon words, introduced in the progress of language. Changes

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* They may be termed the "definitions of derivatives."

are employed in the case of verbs to denote the varieties of time in which the event may have taken place. Other changes are introduced to express the modes of the event or action, whether affirmative, or conditional, or dependent on a condition, or imperative, or interrogative, or whatever other peculiarity it may possess. So also, in many languages, changes are made to express the different persons of the verb. The agent of the verb is distinguished from the object of the action, and the distinction may be made either by the form of the word, or by its position.*

All these distinctions, and many others though introduced by custom alone, and without any view to ulterior advantages, are of the nature of definitions, and serve the purposes which definitions always serve, to abbreviate language, and to render it precise.†

The same distinctions are made, though in a different way, but for the same purpose, and by analogous means, in the language of signs, employed in teaching the deaf and dumb. In this interesting and most humane science, in which signs alone, addressed to the eye, are used instead of words, it is manifest, that no progress could be made without the utmost precision and uniformity in the use of the signs employed. The intention is therefore, no doubt, fixed by such explanation as amounts to the nature of a definition, in whatever way that explanation is conveyed; and such changes or modifications are introduced into the use of this sign, as are fitted to make it capable of conveying the same variations of the idea, as are conveyed in ordinary language by the grammatical distinctions, or the definitions that have been mentioned.

Having ascertained that these distinctions are, in all languages, even in that of signs, of the nature of definitions, let us shortly con-

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* Changes in the form of words are adopted to express the varying extent of a quality, and are commonly named the degrees of comparison, whether in adjectives or adverbs. Some conjunctions are employed to express a continuation of similar objects, others opposition, some to express conditionality, others causation, and others deduction. Syllables are frequently placed at the beginning of words, to render affirmatives negative, and the contrary.

† The grammar of any particular language, consists of neither more nor less than a collection and combined view of all the definitions of this kind, which the practice of that language has introduced. The definitions of the former kind, belong rather to the science of universal grammar, as being such as are applicable to all languages. Those now under consideration, constitute the grammar of any particular language. Hence appears the absurdity of the prejudices, which some modern innovators have conceived against grammar rules; these being the philosophical principles of the language of which they treat.

sider what uses they serve, and afterwards what are their imperfections.

First, what is their use? Why is it, that after having it settled among a society of human beings what idea shall be conveyed by the word *strong*, it is afterwards agreed that a particular modification of this idea shall be expressed by the word *stronger*, and another by the word *strongest*, that still further modifications of the same idea, shall be conveyed by the noun *strength*, and the verb *strengthen*, and the adverb *strongly*? Why are these changes made upon the word, and why are these new forms of the word limited to the ideas commonly conveyed by them? The answer will readily occur. The objects attained by these changes of the word, are brevity and precision. Brevity introduced the custom; precision is found to be promoted by it, and is a much greater advantage than that which actually was intended.

Brevity was the object aimed at in these changes, or virtual definitions. Thoughts rise in the mind, and succeed one another, in far more rapid succession, than any language can express them. Every method, therefore, which improves the quick and ready transmission of thought, is eagerly adopted, and almost invariably practiced. And more especially when the same idea occurs frequently in any discourse, we naturally seek for shorter methods of expressing it, being tired and dissatisfied with every thing circumlocutory. Proofs of this may be readily found in the examples already produced. How the comparison so readily and clearly denoted by the word *stronger*, was expressed before this form of it, or one corresponding to it, was adopted, it is not easy to ascertain with certainty. Perhaps by a repetition of the word strong. More repetitions might have been used to express the idea now denoted by the word strongest. To denote *strength*, some such phrase as "being strong," must have been employed; and in place of "to strengthen," "to make strong," and instead of "strongly," "in a strong manner." It is manifest that the introduction of these shorter expressions must have been felt as a relief by every speaker.

But the brevity which was so much sought for, and which gives so much satisfaction, in these abbreviated expressions, is far from being the greatest advantage to which they gave rise. Before the abbreviation took place, there must have been much room for variety of expression, and consequently for uncertainty in the idea conveyed. By adopting one uniform mode of expressing the same idea, a great

degree of precision is attained, and much ambiguity obviously avoided. A nearer approach is made to that which forms the object of all language, an accurate transmission of thought. When the same form of expression is invariably used to denote the same idea, then the idea itself becomes uniformly connected with that expression, and is presented with readiness and perspicuity to the mind of the auditor. Doubt, hesitation and uncertainty, are excluded from his conception of the thing expressed. But every deviation from that uniform mode of expression, from whatever cause it arises, is followed by doubt and uncertainty, the effects which we wish, above others to avoid, and which, in fact, render our attempts to convey information nugatory.

Having thus ascertained the manner in which these definitions are formed, let the imperfections that have hitherto attended them, be next considered. While we admire the beneficence of the Deity in enabling man to make these distinctions, we cannot avoid being surprised at the egregious folly of man, on account of the capriciousness with which he has carried them into effect.

To begin with one of the plainest examples, the distinction between the singular and plural numbers, is most clearly understood, and well defined; yet there is no language in the known world, ancient or modern, in which it is expressed in one uniform manner. The modern languages are on the whole, more uniform than the ancient, yet even in them there are many exceptions. That "there is no rule without exceptions," seems to be a maxim invented by grammarians, and principally applicable to theirs only; for it has nothing to do with the exact sciences, and very little with the physical ones. The plural number is pretty generally formed in English and French by the addition of the letter *s*. The latter does not pronounce it, and there are numerous exceptions in both. The ancient languages are less uniform. It is a remarkable fact, though it hardly belongs to the present subject, that the oldest languages in Europe, appear to have formed their plurals in two ways, by the change of a vowel, or by the addition of an *s*. The modern Italian appears to have adopted the former method, the French and English, the latter.

It is to be observed, that the irregularity here complained of, is not in the definition itself, which is abundantly clear and explicit; but in the varying terms which are adopted for its expression. A language which would always express the plural number in the same

way without any exceptions, would cut off many sources of ambiguity.

But the irregularities found in the expression of number, sink into insignificance when compared with those which relate to the distinction of gender. I am not aware that there is any known language, except the English, in which that distinction is founded in nature, and the corresponding accuracy of expression preserved. In all others, it is a mere load to the memory, and consequently a hindrance to readiness of expression, and an interminable obstruction to perspicuity. Many languages have only two genders, and consequently arrange all the names of inanimate objects, without any intelligible rule of distinction, under the masculine or feminine genders. Others have three genders, but still with the most capricious contempt of order distribute the names of inanimate objects among all the three.

In the degrees of comparison, most languages have been more uniform. Yet all of them have even in this respect, useless irregularities.

The want of genders and numbers in English adjectives, is probably a defect in that language. A uniform mode of forming them, corresponding to their substantives, would probably have been an additional source of precision.

It is scarcely necessary to bring forward more examples of this irregularity. I would only allude to, but not dwell on the great complexity of the declensions and conjugations in the ancient languages. That there should be five or six modes of producing the same alterations on different nouns, and as many on different verbs, is an extraordinary instance of the caprice of custom.

All these irregularities, and many others that might be mentioned, both in ancient and modern languages, are occasioned by the same cause. They are consequences of languages being entirely formed by chance, and custom and caprice. The writers on grammar come too late with their rules, to remedy the anomalies which desultory practice had long sanctioned. Nations have never been willing to allow their languages to be reformed according to any principle. They all act as if their language was sacred, the product of some celestial understanding, which no mortal had a right to change or improve. All that is permitted to grammarians, is to collect and methodize the practices which custom has introduced, however wild and incongruous they may have been. But mankind always follow

some analogies, and these when collected, form the first rudiments of every grammar.

To form a perfect language, or one as perfect as human nature admits, it would be necessary to express all the corresponding changes of idea, by similar and corresponding changes in the primitive word. All exceptions must be lopped away. Every rule must be invariably applied as far as it is applicable. A uniform mode of declension and conjugation, must in all cases, be followed. All words, as far as possible, ought to be restricted to one meaning, and a uniform method of connecting sentences, according to their associated ideas, ought as nearly as possible, to be pursued.

A language, formed on these principles, would be learned with more ease, retained with more certainty, would prove a more prompt and more certain vehicle of thought, aud would promote the improvement of the intellectual faculties themselves.

Art. IV.—*Remarks on the Geology of Western New York;* by Geo. E. Hayes.*

Geologists seem to have regarded the western counties of New York as a secondary region. The horizontal position of the strata, the salt springs and beds of gypsum, the evolution of carburetted hydrogen from the rocks in various places, and the entire absence of all trap rocks, are circumstances which would naturally direct the attention of geologists that way. With some, they have been considered sufficient evidence to establish the secondary character of the whole region; while a late writer in this Journal has supposed all these horizontal strata equivalent to the formation containing the lias of Europe. To me it would seem that the correctness of these opinions may well be doubted. From the few examinations I have been able

* Buffalo, Oct. 15, 1836.

To Prof. Silliman—*Dear Sir,*—Claiming nothing more than the character of a learner in the science of Geology, it is with no little hesitation I venture to send you the result of my observations, in the attempt to apply the principles of the science to the rock formations of this region. I do not know that these observations contain any thing new to your readers, or of sufficient interest to deserve a place in your valuable Journal. Of that, sir, you are a competent judge. It does seem to me, however, that the subject is not well understood; at least, it is so encumbered with new names, as to be a source of much perplexity to a *learner*.

Respectfully, your obedient servant, Geo. E. Hayes.

to make, as well as from the published descriptions of Prof. Eaton and others, I cannot resist the conclusion, that all these rocks are older than the secondary formation, and owe their origin to that train of causes, whatever they were, that produced the transition rocks.

The metalliferous limestone of Eaton, which occurs at Trenton Falls, and extends to the east end of Lake Ontario, seems to be well characterized as the *lower* transition limestone. It contains several species of the trilobite family, and other characteristic fossils. It passes under graywacke on the south, which in its turn, is overlaid by a conglomerate rock, or millstone grit. Then comes the saliferous rock, so important to the economy and commerce of this State, overlaying the millstone grit, and by its northern outcrop, forming the southern shore of Lake Ontario. If the views here entertained are correct, this saliferous rock must be considered equivalent to the *old* red sandstone of European writers; separating as it does through its whole extent, the lower from the upper transition limestone. Wherever I have had an opportunity of examining its strata, they have an evident dip towards the south. In structure, it varies from a fine grained sandstone to a soft shale, or slate; and in color, from red to a dull green. Although it forms the floor of the salt springs at Onondaga and several other places further west, I see no reason to conclude that this rock contains the mineral salt itself, or that it is the only source from which it is derived. But from the fact that brackish springs, or "licks," as they are called in the western country, issue from some of the superincumbent strata, I should conclude that it acts as a vast reservoir—collecting the water which has become impregnated with the salt in passing through some of the superior formations. In Ohio and Pennsylvania, the saliferous rocks underlay the bituminous coal formations. Their general dip there also is towards the south, or southwest, while at some places they are pierced, by boring at a depth below the present surface of the ocean. The thought has often struck me, (and I see nothing improbable in the supposition,) that the saliferous rocks in Ohio, Pennsylvania, and New York, belong to one vast, continuous formation, having its northerly termination and outcrop in the latter State, on the shore of Lake Ontario.

Lying upon this sandstone, or separated from it by shale, containing layers of argillaceous iron ore, is that vast calcareous formation, which presents so conspicuous a feature in the geology of this district. It extends through the western part of this State, having its

northern outcrop and termination nearly parallel to that of the sandstone beneath, forming the mountain ridge through which the canal is excavated at Lockport, the upper portion of the precipice at the falls of Niagara, and the bed of that river from those falls to Buffalo. How far it forms the bed of Lake Erie cannot be well ascertained. Lying on the saliferous sandstone conformably, it dips in the same direction. At Queenstown heights, the geodiferous portion of this rock attains an elevation of ninety feet higher than the level of table rock at the falls, six miles above, where it passes under the cherty, or cornitiferous strata. This latter portion forms the rapids above the falls, by the water passing over the basseting edges of its strata. At Black Rock it rises twenty or thirty feet above the surface of the river, but declining towards the south, it disappears below the surface of Lake Erie, eight miles south of Buffalo; at which place, it passes under shale or graywacke slate, and is not again seen rising above the water's surface. The eastern shore of Lake Erie is nearly or quite destitute of limestone till we get into the vicinity of Sandusky. The specimens from that place present a far different appearance from any that occur in this region, and I have no doubt, belong to a more recent formation. One specimen in my possession is decidedly oolitic. By following the Niagara River from Lewiston to the Falls, at the water's edge the stratification can be examined to great advantage, and on a larger scale than at any other place. The general dip to the south is there very perceptible.

In looking over Bakewell's description of the mountain limestone of Europe, I have been greatly struck with the similitude of this formation in all except the nearly horizontal position of its strata, and its want of the beds of interposed trap. Had igneous action been active in this vicinity at the time, or subsequent to its deposition, upheaving the strata, and injecting the melted lava between their layers, the resemblance would have been complete. Cracks and seams would likewise have been formed, which, ere this, by galvanic, or some unknown agency, would doubtless have been converted into veins of the metallic ores, and other minerals usually accompanying the mountain limestone. The same remarks apply with equal propriety to the red sandstone below; of which Judge Gibson says, that "a Pennsylvanian is struck with its resemblance in all but its flatness and want of greenstone trap, to the old red sandstone of the Connewaga hills." Now as volcanic action alone is sufficient to account for this difference in appearance, and as this

action is probably in all cases a matter of accident, if I may so speak of any of the great phenomena of nature, it follows that in determining the relative age of rocks, these appearances must be left entirely out of the account.

Although the ordinary and more palpable effects of volcanic action are not discernible, it would seem, from the highly crystalline texture of much of the limestone, that it had been subjected to a considerable degree of heat, many of the fossils having been nearly obliterated, and having assumed the same crystalline texture as the rock itself. In some places this limestone contains numerous geodes of crystals, consisting principally of calcareous spar, dolomite, selenite, snowy gypsum, and celestine. Very small crystals of quartz also sometimes line these geodes, and show through the transparent selenite with a splendent lustre. Galena and blende also occur disseminated in the upper layers at the Falls; and green malachite has been found at Black Rock. It resembles the mountain limestone also, by containing in its upper strata numerous layers of chert, or hornstone. At Black Rock, and many other places, the siliceous part constitutes the greater portion of the rock, and forms a building stone of great hardness and durability. Where the calcareous portion has been disintegrated and removed by the action of the weather, it presents an exceedingly harsh and jagged appearance, and is most significantly called by the laborers "chawed stone." The caverns at Schoharie Kill, and at Bethlehem, are said by Prof. Eaton to occur in this rock; at which places, the imbedded fossils, so far as I can learn, greatly resemble those found farther west.

Thus far, I have not touched on the fossil characters of these supposed secondary rocks: and it is here the geologist will look with most confidence for those characters by which alone he can read the history of those changes which have taken place on the earth's surface to prepare it for the reception of his own species; the last great work of the days of creation. Did these rocks belong to the lower secondary we should expect to meet with some vestige of a former vegetation. Now what is the fact? Not a fossil of vegetable origin, nor the impression of a single leaf is met with. Those entombed in these rocks are entirely of marine origin, and from the entire absence of marks of vegetation, it would seem they inhabited deep waters. Madreporites, terebratulites, orthoceratites, milleporites, encrinites, and corallines, make up by far the greater part. Others occur, some of which I have not been able to make out. The trilobite, which

has been considered peculiarly characteristic of transition rocks, also occurs in the superincumbent shale. It has been found at the mouth of Eighteen Mile Creek, on the shore of Lake Erie. Specimens may also be seen at Mr. Barnett's museum at the Falls, found in that vicinity. In speaking of the trilobite family, Dr. Thompson, in his recent work on Mineralogy and Geology, says that "no traces of them have been discovered in the lias, nor new red sandstone, nor even in the coal beds."

With the cornitiferous strata above described, terminates what I believe to be the upper transition limestone. The superincumbent strata present a mixed character. The fossils are mostly the same as those already mentioned; showing that the same animals continued to inhabit the same seas; while on the other hand, the thin beds, or rather insulated patches of bituminous coal, mostly, I should think, the product of single plants, begin to make their appearance; showing likewise, that some portion of the earth's surface near by, had emerged from the waters, and was in a fit condition to support the growth of vegetables. I have not even here met with the impression of leaves, &c. but farther research may yet bring them to light.

The lower portion of these strata, where seems to commence the change from the transition to the coal formation, are mostly composed of soft shale or slate, sometimes bituminous, and containing large quantities of iron pyrites. This shale alternates with strata of impure limestone from one inch to one foot in thickness, which also contain iron pyrites disseminated and forming a thick coating on their under surface. The lower portion of this shale contains more or less carbonate of lime, varying from the least perceptible quantity to one half or more of its weight; constituting a marl of great value for agricultural purposes. It is principally in this marly state that the fossil shells occur. Many of the bivalves are exceedingly perfect, retaining all the delicate markings on their exterior surface; while others are twisted and contorted in a singular manner. Others again are in a collapsed state, one valve having been crushed in, as if done by great pressure. Beds of this marl have been opened in Geneseo and South Avon, where it was mistaken for gypsum, and used as such in the vicinity; and it would seem, from the results, with equal advantage to the agriculturalist. One specimen from South Avon yielded thirty six, and another sixty per cent. of carbonate of lime. In neither could I detect any sulphate.

It is also from this slate or shale that carburetted hydrogen gas is evolved, at the numerous places denominated "burning springs." But a single instance has come to my knowledge of this gas issuing from any of the inferior strata. At Gasport, six miles east of Lockport, and of course below the limestone strata, gas is said to rise from the bed of the canal; from which circumstance the place doubtless takes its name. I have not examined the place in particular reference to this subject; but from the descent of the canal at Lockport, and the relative thickness of the limestone formation at that place, I have no doubt it issues from the shale immediately beneath, which at the falls is partially bituminous. I am aware that Prof. Eaton has cited the burning springs in the vicinity of Canandaigua as issuing from "beneath the saliferous rock." Now from a long residence in that village I am quite sure that the saliferous rock no where comes in view near that place. The village itself is underlaid by limestone, which, I have good reason to believe, passes under the superincumbent shale, about half a mile southwest of the principal street. The nearest place where the gas issues is in the town of Bristol, about eight miles in the same direction. The shale is there in sight, and constitutes nearly the whole range of hills which extend from there, southerly, to the high grounds in Allegany county. Thin seams of coal have been found at no great distance from the spot where the gas issues. Large quantities of gas are also discharged ten miles south of Canandaigua, near Rushville. There it was conveyed by logs into one of the farm houses, and was used, not only for the purpose of procuring light, but for culinary purposes, and likewise to warm the apartments; no other fuel being used when I visited the place during severe winter weather. It was also used to boil down the sap of the sugar maple in the manufacture of sugar; but some accidents occurring, it was discontinued. I have traced the same formation from this place, likewise, to the high grounds in Steuben county, where one of the head branches of the Susquehanna takes its rise. At Fredonia, where gas is collected in sufficient quantity to light the whole village, it issues directly from bituminous shale; at which place the saliferous rock must be several hundred feet below the surface. The same gas at Niagara Falls on the Canandaigua shore, comes from this shale, or from the upper layers of the cherty limestone; the seams of which are there filled with a black, bituminous matter, which can be removed in scales from the thickness of a knife blade to one fourth of an inch.

To me these facts seem conclusive evidence that the gas originates above the saliferous sandstone. Otherwise, it should find its exit through the sandstone itself, near the shore of Lake Ontario, where the least possible resistance would be opposed to its escape. Is it not far more philosophical to conclude, that this gas is formed in these strata, where we know the elements requisite for its composition exist, than to suppose it comes from coal beds deep seated in the bowels of the earth, the bare existence of which is altogether hypothetical?

In passing south, towards the coal beds in Pennsylvania, the higher strata are brought into view. They gradually become more arenaceous, and the limestone entirely disappears. In Steuben and the other counties in that range, to Lake Erie, the principal surface rock is a close, fine grained sandstone, or graywacke, frequently containing encrinites, and some other marine fossils. I have not, myself, had the pleasure of examining the bituminous coal beds in Pennsylvania, but we are informed by Dr. Hildreth, in his admirable treatise on the coal deposits of the valley of the Ohio, that at their most northerly limit, they crop out on the northerly slope of the high grounds in which some of the head branches of the Allegany, the Susquehanna, and the Genesee rivers take their rise, at which place the coal strata dip towards the south, or in the direction of the streams that fall into the Ohio River. It would seem, therefore, that these coal beds overlay, and rest conformably upon this shale and sandstone, which, as I before remarked, seems to form an intermediate link between the transition rocks, and those which properly belong to the coal formation.

If, as is taught by Bakewell, all rocks which underlay the regular coal formation, are older than the secondary, the transition character of this region does not admit of doubt; unless, indeed, it should be contended, that the immense deposits of coal in the Ohio valley do not belong to the *true* coal formation. To doubt this, after reading the luminous account of Dr. Hildreth, before adverted to, would be to doubt the fundamental principles of the science itself.

Art. V.—*On Zinc, as a Covering for Buildings;* in a letter from Prof. A. Caswell to Messrs. Crocker, Brothers & Co.

You some time ago requested me to examine an article on *Zinc, as a roofing material*, published by Dr. Gale of New York, in a late number of the Mechanics' Magazine. I regret that it has not been in my power to give your request earlier attention.

The remarks of Dr. G., which were copied by several papers at the time, were fitted, in your opinion, to prejudice the public mind unjustly upon a subject of great importance. He discourages the use of zinc as a roofing material, upon several distinct accounts, the principal of which are the following.

1. The difficulty of making the roof tight.

2. The deterioration of the water which falls from it.

3. The comparatively small resistance which it offers to the progress of fire.

1. As to the first of these objections, the brittleness of the metal and its great expansion from heat are adduced, to show that a roof cannot be made sufficiently tight. Zinc in the *unwrought* state is well known to be very brittle, and there may be in the market *rolled* or *sheet* zinc of a bad quality. But no one need be deceived on this point, since nothing is easier than to test its flexibility. Sheet zinc which will bear to be doubled and hammered down without any appearance of fracture in the bend, may be used as a covering for buildings, without the least fear of leakage. Such is the fact with regard to sheet zinc which I have examined from your manufactory; and such, I am assured, is the fact with regard to foreign zinc from the best manufactories. But any detailed examination of the brittleness and expansion of zinc, so far as this question is concerned, is entirely obviated by the well ascertained fact, that there is no practical difficulty in making a zinc roof *perfectly tight*. The numerous certificates which you have submitted to my examination, from most respectable gentlemen, who have made the experiment, place the subject beyond all reasonable doubt. A zinc roof may as easily be made tight as any other whatever.

2. The second objection respects the deterioration of the water which falls from the roof. This consideration is particularly important to all those who are in the habit of using cistern water for culinary and other domestic purposes.

It is alledged that a *poisonous* suboxide of zinc is dissolved in the water, which renders it unfit for *cooking*, and impairs its properties for *washing*. On this point I have consulted the ablest modern writers on chemistry, Brande, Turner, Thomson, Berzelius, and others. The oxides of zinc seem not to have been much studied. The principal one known, and perhaps the only one certainly known, is the white oxide, (sometimes called the flowers of zinc,) which is quite *insoluble* in water, and hence could not vitiate its properties. Berzelius thinks there are two others, the suboxide and the superoxide.

The *suboxide* is the gray coating formed on the surface of zinc by exposure to the weather, and this is the substance which, it is said, is dissolved and mixed with the water, which falls from a zinc roof, thereby impregnating it with deleterious properties. This opinion, so far as I can learn, is unsupported by any writer on chemistry. Turner says, "zinc undergoes little change by the action of air and moisture." Aikin's Chemical Dictionary, a work of merit and authority, says, "the action of the air upon zinc, at the common temperature, is very slight; it acquires a very thin superficial coating of gray oxide, which adheres to the metal and *prevents any further change*." The statement of Thomson is, that zinc, when exposed to the air, soon loses its lustre, but "*scarcely undergoes any other change*." The account given by Berzelius, the ablest chemist of the age, is very explicit and much to the point. He says, "this oxide is formed on the surface of zinc which remains a long time exposed to the contact of the air. It has a dark gray color when moistened, but by drying becomes of a light gray. Ordinarily it forms a thin crust on the surface, which neither *increases* nor *experiences any change in the air;* but acquires great hardness, and resists, better than the metal itself, the mechanical and chemical action of other bodies. A piece of zinc sufficiently suboxidized at the surface, dissolves with *extreme slowness in the acids, and only at the boiling temperature*."

Such are the opinions of chemists, and particularly of Berzelius, whose unrivalled skill and accuracy in chemical analysis, have been the admiration of all cotemporary chemists.

The opinion of Dr. G. is considerably at variance with those now adduced. I think he has not stated very fully, and certainly not very satifactorily, the reasons on which it is founded. He mentions, however, as a proof that this suboxide is dissolved in water from zinc

roofs, that if it is suffered to stand for some time exposed to the air, the suboxide gradually takes oxygen from the atmosphere, and is thus converted into the *insoluble* white oxide before mentioned, and is then precipitated in the form of a white powder. To test its purity by this method, I have kept water from a zinc roof exposed in clean glass vessels for several days, without any, the slightest appearance of a precipitate, or even a pellicle upon the surface. And what is still better as a test, I have kept it for several days in closed bottles with oxygen gas, and subjected it to frequent agitation, without the least appearance of a precipitate, or any diminution of transparency. I must think, therefore, that if such water contains the suboxide of zinc, its presence is not to be detected in this way.

That the quantity of zinc dissolved in water *must be exceedingly small*, is obvious from the following consideration. A sheet not more than the fortieth of an inch in thickness, would probably last at least half a century, on the roof of a building. Indeed, for any thing we know as to the *rate* of its oxidation, it might last for centuries. The concurrent opinion of chemists, and this confirmed by observation and experiment, so far as these have extended, is, that after the gray oxide is once formed, any further change takes place *scarcely at all*, or with *extreme slowness*. But on the supposition that it would last only fifty years, the whole quantity of rain which falls in the course of a year, or about three feet on the level, would dissolve the *two thousandth part* of an inch in thickness of zinc. This, to produce any appreciable effect, must be one of the most virulent of poisons, equal at least to prussic acid. But so far from being an active poison, it remains to be shewn that it is poisonous at all, even if a minute portion of it did mingle with the water. The white oxide of zinc is not poisonous, and the inference seems to be gratuitous that this is so.

It is due no less to the public than yourselves, that the truth upon this subject should be known and promulgated. I am quite satisfied, for one, that we are not in the least danger of being poisoned by the use of water from zinc roofs. The portions of this water which I have examined, could not be distinguished from pure river water by any test that I have been able to apply to it. I feel myself warranted, therefore, in the conclusion, that *it has suffered no deterioration whatever from the zinc.*

3. A third objection is that zinc affords inadequate protection against fire.

This objection is based upon the fact that zinc melts at a low temperature; and in case of fusion, leaves the wood work of the building unprotected. This objection is rather specious than real. Zinc melts at the temperature of about 700° Fahr. or a little below red heat. Whenever, therefore, the heat from adjacent buildings is any thing less than that of redness, zinc would afford as complete protection as copper or iron. When the heat has reached the melting point of zinc, which it seldom would do except in the most compact parts of cities, very little confidence could be placed in the protection of iron or copper. The dry wood work of the roof, under a covering of red hot iron, with air enough for combustion circulating through openings and crevices, would soon be in flames; and when once in flames it would be extremely difficult to extinguish it by the application of water. It would be applied with great disadvantage to the under side of the roof, and almost to no purpose at all upon the top. If therefore the heat, in any case, should become so intense as to melt zinc, the probability of protection from iron or copper will be but small.

Complete protection against fire is perhaps unattainable; at least we can never be sure that we have attained it. In the progress of the arts, great improvements no doubt will be made in the mode of defence against the attacks of this destroyer. I am not aware that the following construction for a roof has ever been tried. For cheapness, tightness, durability and resistance to fire, it seems to be well deserving the attention of builders. Let the rough boards of the roof, (and the rougher the better,) be covered with a thick coating of common lime mortar,—then lay down the *ribs*, if I may so call them, for the zinc plates,—then cover the whole with zinc, according to the most approved method of applying it. Such a roof would be in no danger of leakage, unless the water accumulated upon it so as to stand above the ribs, in which case no roof would be tight unless it were calked or soldered throughout. This covering, if I am rightly informed, would be nearly as cheap as slate—quite as cheap as tin, cheaper than iron, and more than three times cheaper than copper; and would at the same time resist fire much better than either of them. A heat that would melt down the copper and iron, would, of course, melt the zinc, but would leave the mortar uninjured. The peculiar advantage of the mortar is, that it is infusible except at a very high temperature, while the closeness with which it adheres to the wood work is such as to exclude the air and thus

prevent combustion. If the mortar should be kept at a red heat for some length of time, the wood beneath it would be *charred*, but could hardly be *burnt*. In case of fusion the zinc might be replaced without injury to the mortar. I know of no construction for a roof that would be more completely fire proof than this.

Such are my views on the subject to which you called my attention. If they shall serve, in any measure, to remove prejudice, and allay unfounded apprehensions on a subject of great and growing importance to the public, it will afford me much pleasure.

Brown University, October 1, 1836.

Art. VI.—*An account of a Hurricane, which visited Shelbyville, Tennessee, June 1st,* 1830; communicated to the Connecticut Academy, by Dr. J. H. Kain.

Few occurrences give us such awful conceptions of the power of the unrestrained elements, as the agitations of our atmosphere. Accounts of storms at sea are common, and to those who make the great waters their home, they are every day occurrences. But, happily for the human family, such hurricanes as that which visited Shelbyville in 1830, are rare. The ocean is easily agitated and thrown into violent commotion; but it requires a much more powerful wind to disturb the repose of those solid bodies which the earth's gravity has bound to her bosom. The effects of a storm at sea are much less dreadful and terrific than the devastations of a land hurricane. A fine ship may safely weather the most violent gale at sea; but probably no building or work of man could encounter, without instant destruction, the fury of the hurricane when it meets with the unyielding resistance of the solid land. Not only are massy buildings torn to pieces and scattered about in astonishing confusion; but the largest trees are twisted off at the trunk and hurled aloft like pieces of paper in an ordinary breeze.

Some countries appear to be more subject to tornadoes than others. This is a well known feature of the climate of the West India Islands. Numerous vestiges of hurricanes are seen in Tennessee. In some places you may trace for thirty miles the track of a tornado, which has prostrated the forest in its course, and piled up its ruins in large masses; sometimes they appear quite recent, and nature has not repaired the waste; the splintered stump is still standing, the

bark still covers the prostrate trunk, the branches and tops of trees are still intertwined, and perhaps even the brown and decaying verdure of the leaves presents the appearance of a premature autumn; the roads are stopped up and impassable; fences and farm houses have disappeared; the corn, wheat and cotton lie flat upon the ground, as if a roller had passed over them; in some places large piles of drift are seen heaped against a hill or rock, and the mud has settled upon and buried the vegetable productions of the earth. At other times you see merely the vestiges of an old hurricane. A new growth has sprung up in the woods, and you may remark the uniform size of the young trees, all dating their age from the same epoch. The bark has decayed away, and the large trunks of the fallen trees are covered with moss; their limbs and tops have rotted and disappeared, and the roots are still distinguished by the mass of earth which was torn up with them, and is now settling down, and still by the uniformity of their position mark the exact course of the hurricane, the root always being towards the point of the compass from which the wind blew. In other places we may find the vestiges of still more ancient date. The process of decay has been completed: even the trunks of the fallen forest have disappeared, a tall, rich, and luxuriant growth has again overspread the earth, and we can only read the history of former devastations in the numerous hillocks of yellow, upturned earth, left by the roots of trees, which, after being blown down, have entirely disappeared and mingled with the rich, black soil in which they had grown. The tracks of these hurricanes are not often more than one hundred rods wide, and vary from a mile to twenty or thirty in length. You can never tell from the direction in which the trees have fallen, the general course of the hurricane. This is usually from southwest to northeast, but though the trees at any particular spot lie parallel to each other, their direction varies very much at different places of the same track. At one place they have fallen with their tops to the north, at another they have fallen towards the south, and at another to the east or west. This fact strengthens the theory of Mr. Redfield, which ascribes to winds, storms and tempests a gyral form.

It will be remembered by those who have read Mr. Redfield's very ingenious essays, that he suggests the theory that the storms which visit our coast rise on the Gulf of Mexico, and assuming a gyral motion, sweep over the United States from the southwest to the northeast. It is known to all who have resided in the great Val-

ley of the Mississippi that there is a constant current of air setting in from the Gulf and blowing up our water courses. This is occasionally interrupted for a few days by a wind in a contrary direction, accompanied usually by rain. Probably this is only an apparent variation produced by the gyral motion of the wind operating on a very large and extended scale. The smaller gyrations which produce our thunder gusts and tornadoes come very sensibly from the southwest. It will be seen from an inspection of the map of North America, that the mountains of Tennessee present the first obstruction which this great southwestern current of air meets with in its progress across our continent. That country is in a position which, while it catches and is refreshed by the softest zephyrs and the most refreshing showers of this great atmospheric current, likewise exposes it to the first rude blasts of its angry tempests. More than any other portion of the United States it bears on its bosom the scars of many an awful contest with this tremendous power, and its uprooted forests tell us too plainly the overwhelming force of the unconquered enemy.

The writer had an opportunity of witnessing one of those awfully grand and terrific convulsions of the atmosphere, which nearly destroyed the town of Shelbyville, in the month of June, 1830. For some days previous to the catastrophe the air had been unusually calm, sultry, and oppressive. It was a very fortunate circumstance for the inhabitants of the village that they were reposing quietly in their beds when the tornado swept over them. Had it occurred in the day time, when the people were moving about, and when the doors and windows were all open, the loss of life must have been much greater. It may be well to remark here, that it was found from the experience of that night, that the complete closing of doors and windows, so as to exclude the external atmosphere, was of the utmost importance. Not a house stood, whose doors and windows were left open, or were too weak to resist the impulse of the wind. On the night of the storm at Shelbyville, a strong western gale blew throughout the State of Tennessee, and several distinct gyrations were formed in different portions of the current. The town of Charlotte, sixty miles northwest from Shelbyville, was blown down two hours before the destruction of the latter. Another gyration took place twenty miles northeast of Shelbyville, which destroyed a farm, and was equally violent with that at Shelbyville. The clouds began to cluster in the west, and the wind to blow, at an early hour

of the night, but the storm did not reach its utmost fury till midnight. The lightning was unusually brilliant, the flashes were so continuous as to enable us to see objects with perfect distinctness, and even to read without the light of a candle. This unusual brilliancy of the lightning was remarked in many distant parts of the State. The lightning was not accompanied with very loud thunder, nor did it appear to have struck or injured any object in the neighborhood of the village.

The town of Shelbyville is situated on a hill which fills up, so to speak, a long gorge between two chains of highlands, which lie on each side of Duck River; this hill is at the eastern extremity of the valley. This circumstance contributes very much to the pleasantness of the site for a town, commanding a fine view, and catching every breeze of summer; but it likewise exposes it to the fury of every gale that sweeps up the river. The court-house occupies the brow of the hill. Around the court-house is a small square or common, and on the four sides of this square are built the principal stores and shops, the bank, and the taverns. It was on this part of the town, that the hurricane exerted its greatest violence. Few families resided in this portion of the village; and it was mercifully ordered that the catastrophe should occur at an hour when the inhabitants had retired from the business part of the town. The wind had blown with great fury and violence without doing any injury for three hours, when suddenly the houses began to crack, and in fifteen seconds the besom of destruction swept over the devoted village, and left it a mass of ruins. Those who were within the range of the tempest were warned of their danger by the shaking of their houses the moment before they fell. A change of position saved the lives of some, and caused the death of others. Some found themselves suddenly in the open air, surrounded by falling timbers, planks, and bricks; others were buried in the ruins of their houses. Some met death whilst endeavoring to escape; others perished in their beds, crushed beneath their falling dwellings. Only five persons were killed. A few were dreadfully bruised, who recovered from their wounds. The interpositions of a merciful Providence for the preservation of life in the midst of such danger, were numerous and astonishing to all who knew the facts, and so much out of the way of common events, that they would scarcely be believed on the testimony of a single individual. Whole families were rescued from the ruins of their houses without any material bodily injury. Individuals were

blown about in the air like feathers and escaped without a scratch. A young lady of uncommon courage and presence of mind, who was out of doors, and had escaped from a falling house, described the scene as awfully grand and magnificent. "I looked," said she, "for well known places, and they had vanished. I turned to go into the house and it was gone. I went for the kitchen, it likewise was not to be found: I looked up and beheld the lightning flashing vividly upon floating planks, plaister, bricks, and shingles, all glistening like white pieces of paper, and filling the air; around me I beheld the white walls of uncovered houses glaring in the light of the storm."

The court-house, a fine brick building, was blown down to the ground. The bank, several taverns, a church, and many stores, shops, and dwelling houses were laid in ruins. Some houses were merely unroofed; others were blown away to the first story, and others were laid prostrate with the ground. The gyral form of the tempest was evinced by the manner in which the materials of the same building were scattered about in different directions, and by the testimony of an individual who declared that he was carried around in a circle of fifty yards diameter with a piece of timber to which he held fast, and by which he was dreadfully bruised. He was picked up two hundred yards from his bed fellow, and in a contrary direction from the house in which they slept. The general direction of the wind was from west to east. The gale was succeeded by rain in quantities almost amounting in devastating power to an avalanche. No hail fell during or subsequently to the storm. The following facts will show the velocity and force of the wind. Laths were shot into brick walls with such force as to penetrate between the bricks, and then turn up and break off, and laths were seen to have penetrated through the boards of houses. Heavy pieces of timber were carried to great heights, and falling penetrated the roofs of houses. Pieces of plank and shingles were carried along the path of the storm, and strewed on the ground for three miles from the town. A book belonging to an attorney, whose office was blown away, was found seven miles from the village. Doors were blown from their hinges, locks and bolts were forced, and if a wall proved strong enough to resist the violence of the wind, large masses of ruins were found piled up against it.

A remarkable phenomenon, which was confirmed by the observation and testimony of many witnesses, was, that sound was not conveyed by the atmosphere to any distance, owing perhaps to its ve-

locity. Not one individual without the range of the hurricane, heard the fall of the houses. The overturning of such a number of houses, in a calm time, would have produced a very loud sound. Still louder would be the sound of so many substances torn asunder, crushed and broken, and dashed to pieces. But no sound whatever was heard by those without the storm, if we except the shrill whistling of the wind, like a loud bugle high in the air. Those who were within one hundred feet of the falling houses did not hear them fall. Nay, we did not hear the fall of the trees, which were torn to pieces and piled around our house. We were not even aware of our danger. Within doors we conversed, and were heard in the ordinary tones; but we were unconscious of what was going on without, until informed by the arrival of fugitives from the awful scene. It was remarked, too, by persons in the falling houses, "we heard nothing but the crash of our own house."

Another fact, which it is important to recollect, is, that it was observed that the corner of the house, on the first floor, next the wind, was the safest part of the building. In a brick house, the cellar was a very unsafe place, because if the joists gave way the cellar was filled with the materials of the building. The side of the house opposite the wind was very unsafe, because the materials of the building were blown to that side. A small portion of the wall next the wind always stood. Brick houses were less safe than framed houses. They were more liable to be blown down, and their materials were more dangerous. A young man saved his life by creeping under a bench, which afterwards sustained a mass of many tons. Some were preserved by getting under their bedsteads. No place in the upper story of a house was safe. The recollection of these facts may be useful to us, should we be so unhappy as to be exposed to a similar catastrophe, though unfortunately at such a time we are not apt to recollect any thing, and are too liable to be deserted by our reason and presence of mind.

P. S. An intelligent farmer, who lived on the high lands, eight miles south of Shelbyville, in a situation which commands a view of the hill on which that village is built, communicated to the writer a fact which is curious, and may throw some light upon the nature of the forces which produce the gyrations of hurricanes. He had risen about midnight to look out on the storm, his attention having been excited by the unusual brilliancy of the lightning, and the continuousness of its flashes. The heavens were overspread with dark

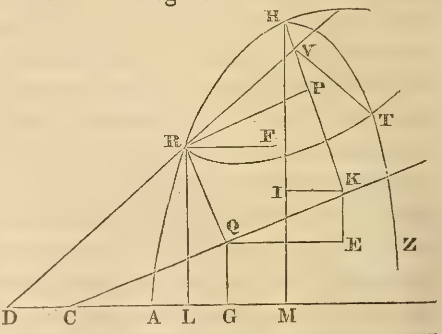
clouds in rapid motion. There was a strong western gale. The lightning appeared to issue from a cloud which was moving very swiftly towards Shelbyville. This cloud was permanently luminous, and between the flashes of lightning of the color of red hot iron. In shape it was double, and the two portions approached each other like the wings of an eagle, and on passing over the village, the wings suddenly coalesced and descended, and then became invisible to the observer. This occurred, as nearly as we could calculate, at the moment when the hurricane swept over the town.

It has been suggested to me by a friend, that at the moment of the union of the two clouds, two contrary currents of air met, and produced the whirlwind, which was so destructive in its effects.

Art. VII.—*On the sections of a plane, with the solids formed by the revolution of the conic sections, about axes situated in their planes;* by Prof. Benedict, of the University of Vermont.

Let ARH be any conic section; AM the line of its principal axis; A its vertex; and CQK any right line in its plane about which it is supposed to revolve. Let DRVT be any plane, the common section of which, and the surface of the solid which is formed by the revolution of ARH is the line RT, whose form it is proposed to examine. Through CK let the plane DRHM pass perpendicular to the plane DRVT, intersecting the surface of the solid in the conic section ARH; and let the common section of these planes be DRV, meeting AM, extended if necessary, at D and ARH at R. Draw RL,RQ perpendicular respectively to AM,CK, meeting them at L and Q. Through any point V in RV which is assumed the axis of abscissæ of the line RT, draw HK parallel to RQ, meeting ARH at H and CK at K. Let HTZ be a section of the solid perpendicular to CK. Let AM,HM, the rectangular coordinates of the point H

Fig. 1.



of the conic section ARH relative to the axis of abscissæ AM, be represented by (t), (u), and QK,HK, the rectangular coordinates of the same point H relative to the axis of abscissæ QK and origin Q, by (t') (u'). Draw RF parallel to AM, and put $\angle VRF=\omega$, $\angle KCM=\varphi$, $AL=d$, $AG=k$, $RQ=\pi$, $QG=\theta$, $RV=\chi$, and VT, the common section of the planes HTZ and RVT, equal to (y). Since ARH is a conic section, the relation between (t) and (u) may be exhibited by the equation $u^2=\frac{b^2}{a^2}(pt+ct^2\,;)$ or $a^2u^2-pb^2t-cb^2t^2=0$; which evidently characterizes a right line when $p=0$ and $c=1$; a circle when $a=b=p$ and $c=-1$; an ellipse when (a) and (b) are unequal, $a=p$ and $c=-1$; an hyperbola when $a=p$ and $c=1$; and a parabola when $a=p$ and $c=0$. Draw KE parallel to HM and QE,KI perpendicular to KE, meeting KE and HM respectively at E and I. The relation between (t') (u') may be determined, agreeably with the usual method of transforming coordinates, by putting $t=AM=AG+QE-IK=k+\cos.\varphi.t'-\sin.\varphi.u'$, and $u=HM=QG+KE+HI=\theta+\sin.\varphi.t'+\cos.\varphi.u'$, and substituting these last values of (t), (u) in the above equation of ARH. From this substitution we have

$$\left.\begin{array}{l} a^2\theta^2-b^2\,(pk+ck^2) \\ +[2a^2\theta\sin.\varphi-b^2\,(p+2ck)\cos.\varphi]t' \\ +[2a^2\theta\cos.\varphi+b^2\,(p+2ck)\,\sin.\varphi]u' \\ +2(a^2+cb^2)\sin.\varphi\cos.\varphi t'u' \\ +[(a^2+cb^2)\sin.\varphi^2-cb^2]\,t'^2 \\ +[-(a^2+cb^2)\sin.\varphi^2+a^2]\,u'^2 \end{array}\right\}=\left\{\begin{array}{l} h \\ +\delta t' \\ +eu' \\ +ft'u' \\ +mt'^2 \\ +nu'^2 \end{array}\right\}=0\ldots.(1);$$

where h, δ, e, f, m, n, represent the corresponding coefficients in the left member. Resolving the abridged equation (1) in reference to (u') we obtain $u'=-\frac{e+ft'}{2n}\pm\left(\left(\frac{e+ft'}{2n}\right)^2-\frac{h+\delta t'+mt'^2}{n}\right)^{\frac{1}{2}}$. But (drawing RP parallel to CK meeting HK at P) $\angle VRP=\omega-\varphi$, and consequently $t'=QK=RP=\cos.(\omega-\varphi).\chi$; therefore, supplying the place of (t') by $\cos.(\omega-\varphi).\chi$ in the equations above, there results $u'=-\frac{e+f\cos.(\omega-\varphi).\chi}{2n}\pm\left(\left(\frac{e+f\cos.(\omega-\varphi)\chi}{2n}\right)^2-\frac{h+\delta\cos.(\omega-\varphi)\chi+m\cos.(\omega-\varphi)^2\chi^2}{n}\right)^{\frac{1}{2}}$ (2). The plane HTZ, being perpendicular to CK, is perpendicular to the plane ARHM, and is also a circular section of the solid. The planes HTZ and

RVT being each perpendicular to the plane ARHM, their common section VT is also perpendicular to RV and HK; and consequently $HK^2 - VK^2 = VT^2 = y^2$. But $VK = RQ + VP = \pi + \sin.(\omega - \varphi)\chi$. Substituting in the last equation this value of VK, and for HK the value (u') in (2), we shall have

$$y^2 = \left(-\frac{e + f\cos.(\omega-\varphi)\chi}{2n} \pm \left(\left(\frac{e+f\cos.(\omega-\varphi)\chi}{2n}\right)^2 - \frac{h + \delta\cos.(\omega-\varphi)\chi + m\cos.(\omega-\varphi)^2\chi^2}{n}\right)^{\frac{1}{2}}\right)^2 - \left(\pi + \sin.(\omega-\varphi)\chi\right)^2 \quad (3);$$

which by an obvious reduction becomes $y^2 = \frac{1}{4n^2}\Big(-e - f\cos.(\omega-\varphi)\chi \pm$ $[e^2 - 4nh + 2(ef - 4n\delta)\cos.(\omega-\varphi)\chi + (f^2 - 4mn)\cos.(\omega-\varphi)^2\chi^2]^{\frac{1}{2}}\Big)^2 -$ $[\pi + \sin.(\omega-\varphi)\chi]^2$, (4); which are the equations, referred to rectangular coordinates of the section of a plane with the surface of a solid formed by the revolution of any conic section about an axis situated in its plane.

The equations (2), (3), (4), are liable to a failing case which, though of rare occurrence, it may be well to notice and make provision for. This happens when $n=0$ or $\sin.\varphi^2 = \frac{a^2}{a^2 + cb^2}$, and is occasioned by regarding (1) as a quadratic equation, which it evidently ceases to be when $n=0$. In this case

$$u' = -\frac{h + \delta\cos.(\omega-\varphi)\chi + m\cos.(\omega-\varphi)^2\chi^2}{e + f\cos.(\omega-\varphi)\chi}, \quad (5);$$ and consequently

$$y^2 = \left(\frac{h + \delta\cos.(\omega-\varphi)\chi + m\cos.(\omega-\varphi)^2\chi^2}{e + f\cos.(\omega-\varphi)\chi}\right)^2 - [\pi + \sin.(\omega-\varphi)\chi]^2 \quad (4').$$

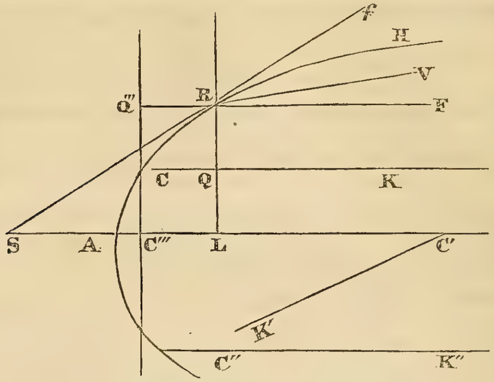
In the application of these general equations to proposed cases it is sufficient merely to remark that (K), (θ), (ω), (φ), are positive in the situations in which they are represented in fig. (1), and change their signs according to the familiar principles of trigonometry. It is evident from an inspection of the figure that (π) and (d) are not arbitrary lines, being dependent upon the equation of ARH and the given magnitudes (k), (θ), (φ). To determine (π), it is necessary only to put (π) in the place of (u') and zero in that of (t') in (2) which expresses the relation between the rectangular coordinates of ARH relative to the axis CK and origin of abscissæ Q. This substitution gives $\pi = -\frac{e}{2n} \pm \left(\frac{e^2}{4n^2} - \frac{h}{n}\right)^{\frac{1}{2}}$; which fails as above when

$n=o$; in which case $\pi=-\frac{h}{e}$, as is evident by putting $\chi=0$ in (5).

If the axis of revolution is parallel to the principal axis of the revolving curve, $\varphi=0$, $\sin.\varphi=0$, $\cos.\varphi=1$, $k=d$, $h=a^2\theta^2-b^2(pd+cd^2)$, $\delta=-b^2(p+2cd)$, $e=2a^2\theta$, $f=0$, $m=-cb^2$, $n=a^2$, and $\pi=\frac{b}{a}\surd(pd+cd^2)-\theta$. Substituting these values, equation (3) is reduced to $y^2\left(-\theta\pm\frac{b}{a}\left(pd+cd^2+(p+2cd)\cos.\omega\chi+c.\cos.\omega^2\chi^2\right)^{\frac{1}{2}}\right)^2-\left(\frac{b}{a}\surd(pd+cd^2)-\theta+\sin.\omega\chi\right)^2$ (6). The most simple as well as useful class of cases embraced in (6) is that in which the axis of revolution is supposed to coincide with the principal axis of ARH. According to this hypothesis $\theta=0$, and (6) becomes $y^2=\frac{b^2}{a^2}\left(pd+cd^2+(p+2cd)\cos.\omega\chi+c.\cos.\omega^2\chi^2\right)-\frac{b^2}{a^2}(pd+cd^2)-\frac{2b}{a}\surd(pd+cd^2)\sin.\omega\chi-\sin.\omega^2\chi^2$, or $y^2=\frac{cb^2-(a^2+cb^2)\sin.\omega^2}{a^2}$ $\left(\frac{[b^2(p+2cd)\cos.\omega-2ab\surd(pd+cd^2)\sin.\omega]\chi}{cb^2-(a^2+cb^2)\sin.\omega^2}+\chi^2\right)$ (7); which is evidently a conic section, and characterizes the section of a plane with a cone, sphere, the spheroids, hyperboloid, or paraboloid, according as ARH is a right line, circle, ellipse, hyperbola, or parabola. If, for brevity, we put $cb^2-(a^2+cb^2)\sin.\omega^2=G$ (8), and $b^2(p+2cd)\cos.\omega-2ab\surd(pd+cd^2)=q$ (9), the equation of the section becomes $y^2=\frac{G}{a^2}\left(\frac{q\chi}{G}+\chi^2\right)$ (10). Conceiving A (Fig. 2,) to be that principal vertex of the solid which is nearest to R, it is evident that $(p+2cd)$ is always positive; for (c) is negative only in the sphere and spheroid, in which cases $c=-1$, $p=a$, and $a>2d$. When the plane RV is a tangent to the solid at R, SL : RL : : cos. ω : sin. ω. But, according to well known properties of the conic sections, the subtangent $SL=\frac{2(pd+cd^2)}{p+2cd}$, and the ordinate $RL=\frac{b}{a}\surd(pd+cd^2)$. Substituting these values in the proportion above and reducing, we have $b^2(p+2cd)\cos.\,\omega-2ab\surd(pd+cd^2)\sin.\,\omega=0$. As RV descends cos. ω and sin. ω continue positive, the former increasing and the latter decreasing till they become respectively (1) and (0) when RV coincides with RF. When RV is situated between RF and

RL, sin. ω is negative and cos. ω positive till RV coincides with RF. As RV departs from RL, sin. ω and cos. ω are each nega-

Fig. 2.



tive, and (q) remains positive till it vanishes when the plane becomes a tangent at R. These considerations render it evident that (q) is always positive except when it vanishes in the case above referred to. Wherefore (10) characterizes a right line when $q=0$ and $G=0$; an ellipse when (G) is negative, including the circle when $G=-a^2$; an hyperbola when (G) is positive; and a parabola when $G=0$. The following examples will answer the purpose of illustration. Let it be required to determine whether a paraboloid is susceptible of an hyperbolic section. In this case (G) being positive and $c=0$, (8) is reduced to $\sin.\omega=\pm\sqrt{\left(\frac{-G}{a^2}\right)}$, which being imaginary indicates the impossibility of the proposed section. Let the hyperbolic section of a sphere or spheroid be proposed. These conditions require (G) to be positive and $c=-1$; and consequently $\sin.\omega=\pm\sqrt{\left(\frac{-b^2-G}{a^2-b^2}\right)}$, which is imaginary in the prolate spheroid where $a>b$, greater than unity in the oblate spheroid where $a<b$, and infinite in the sphere where $a=b$: the section therefore is impossible, in the first case because sin. ω is imaginary, and in the last two cases because $\sin.\omega>$ radius. If the parabolic section of an hyperboloid be proposed, we have $c=1$ and $G=0$, and therefore $\sin.\omega^2=\frac{b^2}{a^2+b^2}$, an equation which implies no absurdity, and indicates consequently the possibility of the section. If ω' denote the angle which the asymptote of the solid makes with its axis, we de-

rive, from a familiar property of the hyperbola, $a^2 : b^2 :: \cos.\omega'^2 : \sin.\omega'^2 \therefore \sin.\omega'^2 = \frac{b^2}{a^2+b^2}$. If $\sin.\omega^2 > \frac{b^2}{a^2+b^2}$ (G) is negative, and if $\sin.\omega^2 < \frac{b^2}{a^2+b^2}$ (G) is positive. Wherefore we conclude that the section of an hyperboloid parallel to an asymptote is a parabola; that, if the section makes a greater angle with the axis of the hyperboid than the asymptote does, it is an ellipse or circle; and that, if the section makes a less angle, it is an hyperbola. To determine the sections of the paraboloid, we put $c=0$, and therefore $G = -a^2\sin.\omega^2$, which is zero when $\omega=0$, and negative in all other cases. Hence it is inferred that the section of a paraboloid parallel to its axis is a parabola, and that in all other positions it is a circle or an ellipse. In the sphere and spheroids $c=-1$ and $G=-b^2-(a^2-b^2)\sin.\omega^2$; which, being always negative indicates that all the sections of the sphere and spheroids are circles or ellipses. The sections of a cone are determined with equal facility. The sections of a cylinder may be derived directly from (3) or (4) by putting $p=0$, $c=1$, and considering the axis of revolution C′K′ (Fig. 2,) to be parallel to ARH, which in this case is a right line. All the parabolic sections of the solids under consideration being characterized by the equation $y^2 = \frac{q\chi}{a^2}$, have for their parameter $\frac{b^2(p+2cd)\cos.\omega - 2ab\sqrt{(pd+cd^2)}\sin.\omega}{a^2}$. All other sections, excepting the right line are characterized by (10) without any change of general form. Putting $\frac{q}{G} = \pm A$ and $\frac{G}{a^2} = \pm\frac{B^2}{A^2}$ (the $+$ or $-$ being used according as (G) is positive or negative) (10) becomes $\frac{B^2}{A^2} \cdot A\chi \pm \frac{B^2}{A^2}\chi^2 = y^2$, or $\frac{B^2}{A^2}(A\chi \pm \chi^2) = y^2$, the equation of a circle, ellipse, or hyperbola whose principal axis is $A = \pm \frac{b^2(p+2cd)\cos.\omega - 2ab(pd+cd^2)\sin.\omega}{cb^2 - (a^2+cb)\sin.\omega^2}$, and its conjugate axis $B = \frac{A\sqrt{\pm G}}{a} = \frac{\sqrt{\pm G}}{a} \cdot \frac{q}{\pm G} = \frac{q}{a\sqrt{\pm G}} = \frac{b^2(p+2cd)\cos.\omega - 2ab\sqrt{(pd+cd^2)}\sin.\omega}{a\sqrt{\pm[(cb^2-(a^2+cb^2)\sin.\omega^2)]}}$. Wherefore also $A^2 : B^2 :: \frac{q^2}{G^2} : \frac{q^2}{a^2(\pm G)} : a^2 :: \pm[cb^2-(a^2+cb^2)\sin.\omega^2]$; which is an

invariable ratio when (ω) is constant, and shews the similarity of all the parallel circular, elliptic and hyperbolic sections of these solids.

If $a=b=p$ and $c=-1$, (6) is reduced to $y^2=\left(-\theta\pm[ad-d^2+(a-2d)\cos.\omega\chi-\cos.\omega^2\chi^2]^{\frac{1}{2}}\right)^2-[\sqrt{(ad-d^2)}-\theta+\sin.\omega\chi]^2$ (11), which characterizes the sections of a solid formed by the revolution of a circle about any axis parallel to a chord, and embraces those curves imagined by Perseus Citicus denominated spiriques. If in this case $\theta=0$, the solid is a sphere; if CK is above AL (θ) is positive, and if below, negative. If $\theta=-\frac{a}{2}$ the axis of revolution is a tangent to the generating circle.

If $\theta>\frac{a}{2}$, (11) is the equation of the section of a circular ring. If in (6) $a=p$ and $c=-1$ (while (a) and (b) are unequal, $y^2=\left(-\theta\pm\frac{b}{a}\left(ad-d^2+(a-2d)\cos.\omega\chi-\cos.\omega^2\chi^2\right)^{\frac{1}{2}}\right)^2-\left(\frac{b}{a}\sqrt{(ad-d^2)}-\theta+\sin.\omega\chi\right)^2$ (12) which the equation of the sections of an elliptical ring which is elongated or flattened towards the axis of revolution according as (a) is greater or less than (b). The equation (6) is reduced to $y^2=\left(-\theta\pm\frac{b}{a}\left(ad+d^2+(a+2d)\cos.\omega\chi+\cos.\omega^2\chi^2\right)^{\frac{1}{2}}\right)^2-\left(\frac{b}{a}\sqrt{(ad+d^2)}-\theta+\sin.\omega\chi\right)^2$ (13), and $y^2=\left(-\theta\pm\sqrt{(pd+p\cos.\omega\chi)}\right)^2-\left(\sqrt{(pd)}-\theta+\sin.\omega\chi\right)^2$ (14), according as ARH is an hyperbola or parabola.

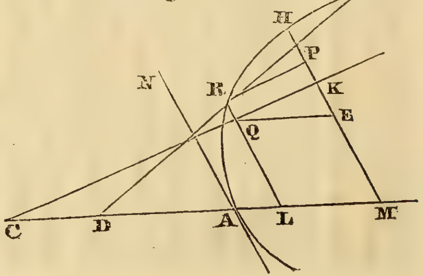
If the axis of revolution C''' Q''' is perpendicular to the principal AL, $\varphi=90°$, $\sin.\varphi=1$, $\cos.\varphi=0$, $AC'''=k$, $RQ'''=d-k=\pi$, $Q'''\,C'''=\theta=RL=\frac{b}{a}\sqrt{(pd+cd^2)}$, $h=b^2(pd+cd^2)-b^2(pk+ck^2)$, $\delta=2ab\sqrt{(pd+cd^2)}$, $e=b^2(p+2ck)$, $f=0$, $m=a^2$, and $n=-cb^2$. Substituting these values in (3) we derive the equation

$$y^2=\left(\frac{p+2ck}{2c}\pm\left(\left(\frac{p+2ck}{2c}\right)^2+\frac{b^2(pd+cd^2)-b^2(pk+ck^2)+2ab\sqrt{(pd+cd^2)}\sin.(-\omega)\chi+a^2\sin.(-\omega)^2\chi^2}{cb^2}\right)^{\frac{1}{2}}\right)^2-$$

$[d-k+\cos.(-\omega)\chi]^2$; which after reduction becomes $y^2=$

$$\left(\frac{p+2ck}{2c}\pm\left(\left(\frac{p+2cd}{2c}\right)^2+\frac{2ab\sqrt{(pd+cd^2)}\sin.(-\omega)\chi+a^2\sin.(-\omega)^2\chi^2}{cb^2}\right)^{\frac{1}{2}}\right)^2-[d-k+\cos.(-\omega)\chi]^2 \ldots (15);$$ an equation which characterizes the sections of a solid formed by the revolution of the conic sections about an axis perpendicular to their principal diameters. In the case of the revolving curve being a parabola, $c=0$, and $a^2-(a^2+cb^2)\sin.\varphi^2=0=n$; which constitutes the failing case remarked above. Assigning the same values to the coefficients as in (15), we derive from (4′) $y^2=\left(\frac{b^2(pd+cd^2)-b^2(pk+ck^2)+2ab\sqrt{(pd+cd^2)}\sin.(-\omega)\chi+a^2\sin.(-\omega)^2\chi^2}{b^2(p+2ck)}\right)^2-$ $[d-k+\cos.(-\omega)\chi]^2\ldots(16)$. These equations may be modified almost at pleasure, by assigning different values to the elements, and a vast variety of curves represented of singular forms and interesting properties.

Fig. 3.



An equation embracing coefficients simpler than h, δ, &c., and in some cases more convenient in application, may be obtained in a manner analogous to the preceding. Draw the tangent NA perpendicular to the axis of revolution CK, touching ARH at A. Let AN and the diameter ALM be the axes of the coordinates RL, AL, HM, AM. Complete the construction as in fig. (1), and employ the same notation, as above. Since ARH is a conic section, we have $\frac{b'^2}{a'^2}(pt+ct^2)=u^2$, in which (a') is the diameter terminated at A, and (b') its conjugate. Put $t=\text{AM}=\text{AL}+\text{Q}e=d+$

$\frac{t'}{\cos.\varphi}$, and $u = \text{HM} = \text{QL} + \text{KE} + \text{HK} = \theta + \frac{\sin.\varphi t'}{\cos.\varphi} + u'$. Substitute these values of (t), (u), in the equation above, there results

$$\left.\begin{array}{l} a'^2\theta^2 - b'^2(pd+cd^2) \\ +\left(2a'^2\theta\sin.\varphi - b'^2(p+2cd)\right)\frac{t'}{\cos.\varphi} \\ +2a'^2\theta u' \\ +\frac{2a'^2\sin.\varphi t'u'}{\cos.\varphi} \\ +(a'^2\sin.\varphi^2 - cb^2)\frac{t'^2}{\cos.\varphi^2} \\ +a'^2u'^2 \end{array}\right\} = 0 = \left\{\begin{array}{l} h' \\ +\delta' t' \\ +e'u' \\ +f't'u' \\ +m't'^2 \\ +n'u'^2, \end{array}\right.$$

in which h', δ', &c., represent the corresponding coefficients in the left member. But as before, $t' = \cos.(\omega-\varphi)\chi$. Wherefore it only remains to supply the places of the letters h, δ, &c., in (3), by the corresponding accented ones h', δ', &c. This furnishes the equation

$$y^2 = \left(\frac{-e'+f'\cos.(\omega-\varphi)\chi}{2n'} \pm \left(\left(\frac{e'+f'\cos.(\omega-\varphi)\chi}{2n'}\right)^2 - \frac{h'+\delta'\cos.(\omega-\varphi)\chi + m'\cos.(\omega-\varphi)^2\chi^2}{n'}\right)^{\frac{1}{2}}\right)^2 - [\pi' + \sin.(\omega-\varphi)\chi]^2;$$

in which the coefficients h', δ', &c. are simpler than h, δ, &c., and in which (n') being equal to (a'^2), is never zero. This equation, to be general, supposes the possibility of drawing a tangent to a conic section parallel to a given line, a problem which is evidently impossible in the case of the hyperbola, when the line parallel to which the tangent is required to be drawn makes a less angle with the principal axis, than the asymptote does with the same axis.

Art. VIII.—*On the Conduction of Water;* by Prof. C. Dewey.

In Vol. xxviii, p. 151, of this Journal, are some details on this subject. In that paper, the inadequacy of Dr. Murray's experiments on this subject was shown. It is certain that when the vessel containing the water and thermometer is formed of *ice*, the power of water to conduct caloric downwards *cannot be shown*, as the heated water, when its temperature is below 40° Fahr., will become heavier, and thence sink to the bulb, and cause the temperature to be higher. If the vessel is not made of ice, and the water on the thermometer is cooled to near 32° Fahr., it will be equally impossible to show its conduction of caloric from particle to particle, for the

very same reason as before, unless the caloric is applied at the bottom. The experiments detailed in that paper were conclusive on the conduction of water when its temperature was above 40° Fahr., unless the caloric were chiefly conveyed to the water along the sides and bottom of the vessel used. In some late experiments on this subject this difficulty has been removed, and the possibility prevented by the following contrivance. A thermometer was immersed in water at 62° Fahr., so as to be three eighths of an inch deep on the bulb, in a large earthen dish. A hollow glass cylinder, four inches in diameter and two inches high, was then placed in the water so as to have the bulb of the thermometer in the middle of the cylinder. The cylinder was prevented from touching the bottom of the dish by three small pieces of wood placed under it. The ether, which was to be inflamed over the bulb, was thus confined within the hollow glass cylinder, so that the generated caloric could not come to the sides of the earthen dish. When heated oil was poured over the bulb, it was confined in the same way. The influence of a heated iron was confined in the same manner. Yet when all these were repeatedly tried, the temperature rose about *six* degrees, except that the iron did not heat it so much. These experiments satisfactorily prove that *caloric passed downwards.* If it was not *radiation,* it must prove the *conduction of water.* The form of the experiment prevents the heating of the bulb by means of the dish. It was clear that the rise of the thermometer soon ceased, as it ought to do if it were conduction; for the heated particles, being made lighter, would be pressed upwards by the cooler and heavier particles around them as soon as the conduction was much diminished by the cooling above. Hence after a few moments the thermometer would begin to fall, although the surface of the water was several degrees above that of the water in contact with the bulb. When an air thermometer, with its stem passing down through the neck of a funnel of glass, and made tight in the neck by a cork, is immersed to the depth of an inch in water over its bulb, and then the hollow cylinder of glass is made to surround the bulb as in the other case, and kept from touching the funnel, and ether is inflamed within the cylinder, the experiment is clearly visible, beautiful and decisive. It is not obvious how any experiment can be more satisfactory than this; any experiment of this character—for we must always except the common one of mixing heated and cold water, when the caloric must *pass from particle to particle,* as the temperature of the hotter is instantly diminished, and of the colder is instantly increased.

Art. IX.—*Breithaupt's new Specific Gravities of Minerals;* by Dr. Lewis Feuchtwanger, of New York.

The indefatigable Prof. Breithaupt, of Freiberg, in whom mineralogy has its most zealous cultivator, and to whom the scientific world owes great discoveries for the last fifteen years, has lately re-examined a great number of minerals the specific gravity of which has in many instances not yet been known at all, and in some instances could not from circumstances be given correctly, and they are:

1. 2.629, Common siliceous schist, lydian stone from Erzgebirge, Saxony.
2. 2.761, Bitterspar, from Iringen.
3. 2.717, Eugnostic calcareous spar, from Rotluf near Chemnitz, Saxony.
4. 4.793, } Iron ore, Ilmenite, from the Uralian mountains, accompanying the zircon in granite, black and conchoidal.
5. 4.794, }
6. 2.330, Comptonite, from Vesuvius.
7. 2.361, The same, from Bohemia.
8. 3.002, Small and fine granular batrachite from Tyrol.
9. 22.109, Native iridium in grains, lately received from Uralian Mountains.
10. 17.840, Two pretty large and pure grains of iridosmin, from Uralian Mountains.
11. 3.185, Fluorspar-crystal, from Switzerland.
12. 1.989, Brown sulphur, from Croatia.
13. 2.724, Scapolite, from Arendal, Norway, fresh greenish grey and hardness 7.
14. 2.241, } Opal, Werner's semi-opal from Freiberg, the hardest known varieties.
15. 2.250, }
16. 3.625, } Stilpnosiderite, from the Voigtland.
17. 3.626, }
18. 2.700, Meroxene calcareous spar, (spar R.$=105°\ 11'$,) from Tharaud, Saxony.
19. 7.198, Calamine leadspar, (white phosphate of lead,) from Zschoppau, Saxony.
20. 3.388, Transparent crystal of epidote, from Piedmont.
21. 3.351, Pyroxene, which deserves more investigation, passing generally for a colophonite from Arendal, Norway.
22. 3.437, Retinophane pyroxene, the common colophonite, from Arendal.

23. 3.830, Colophonite, which is the true dodecahedral garnet and ought to be brought to the Aplome, from Arendal.

N. B. These three substances, generally called colophonite, and not exhibiting any varieties to the eye, have on account of their form of cleavage and crystals been clearly distinguished by Breithaupt as as pyroxene, tetragonal and dodecahedral garnet; the colophonite is most frequently, tetragonal.

24. 3.976, Earthy sulphate of barytes, Saxony.

25. 2.510, Metaxite, from Silesia.

26. 2.518, Picrolite, from Silesia.

27. 2.334, Lasionite, (Wavellite,) from Freiberg.

28. 2.981, Nephrite, greenish grey to mountain green variety, from a lump of 76 lbs.

29. 2.952, Granular tremoline amphibole, (tremolite,) from Sweden, accompanying arsenical pyrites in talcose slate.

30. 2.574, Alum slate from Strehla, Saxony, the only slate where chiastolite has been found.

31. 4.450, Sulphate of barytes, from Saxony.

32. 2.741, Calcareous spar, (the heaviest calcareous spar of $R=105^{\circ}\ 8'$.)

33. 2.705, Polymorphous calcareous spar, (the lighter.)

34. 4.787, A characteristic hepatic pyrites, Freiberg.

35. 3.063, Black schorl, yet belonging to the dicromatic, from Tyrol.

36. 17.300, Four fine pure grains of iridosmin, Uralian mountains.

37. 2.655, Common greenish gray quartz.

38. 2.185, Galapectite, from Silesia, (new mineral and new locality.)

39. 2.702, A mineral similar to magnesite, accompanying the kerolite, from Silesia.

40. 4.202, Almandin garnet, from Freiberg.

41. 3.255, A problematic pyroxene in basalt, from Silesia.

42. 3.320, Black amphibole, from Bohemia.

43. 5.577, Pyrites, Hessia.

44. 6.195, Cobaltic marcasite, (arsenical cobalt,) from Schneeberg.

45. 6.304. The same, in fragmentary crystals, from Hessia.

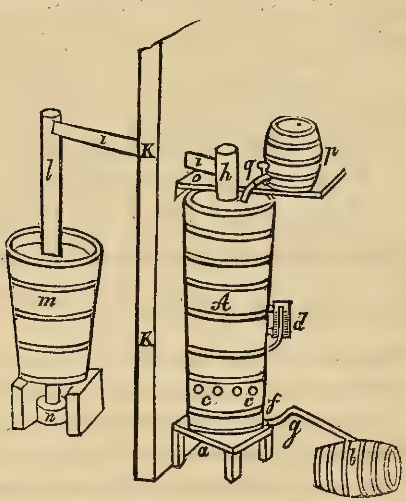
46. 6.361, The same, from Schneeberg.
47. 6.369, The same, from Freiberg.
48. 6.534, The same, fine white, resembling the nickel pyrites, from Schneeberg.
49. 6.565, The same, of regular crystalline dentritic conglomerates, from Schneeberg.
50. 5.029, Octahedral crystalline and reticulated iron pyrites, Schneeberg.
51. 4.284, Berthierite, from the Auvergne.
52. 7.362, Diatome Wolframite, from Brazil.
53. 7.123, White nickel pyrites, (biarsenide of nickel,) Schneeberg.
54. 3.481, Fragments of a large crystal of titanite—variety from Arendal.
55. 2.619, Yellowish white tetartine felsite, (tetartin,) accompanying the topaz crystals of the Uralian Mountains.
56. 9.612, Native bismuth, from Brazil.
57. 1.857, A mineral from near Bonn, said to be Allophane.
58. 1.685, Supposed to be an artificial product.
59. 8.511, Brass from a manufactory—Voigtland.
60. 8.462, The same. "
61. 8.444, " "
62. 8.381, " "
63. 8.351, " "
64. 8.341, " "
65. 2.969, Ouwarowite, from Bisersk, Uralian Mountains.
66. 4.797, Manganiferous ore, Saxony.
67. 3.410, The true Sarkolite, from Vesuvius.
68. 3.239, A green pyroxene, accompanying the sarkolite.
69. 2.083, Hydrolite or Gmelinite, from Scotland.
70. 3.557, Fiedler's Chloritoid, from the Uralian Mountains, accompanying the diaspore and has the structure of mica.
71. 3.489, Manganesian epidote, from Piedmont.
72. 3.547, Topaz, from Uralian Mountains.
73. 2.304, Chrysocolla, from Mexico.
74. 2.966, Tautokline calcareous spar, R=106° 10′, Saxony.
75. 2.995, Dark greenish white arragonite, from Silesia.
76. 2.318, Zeolite, fibrous radiated, from Bohemia, belonging perhaps to comptonite.

77. 2.708, Eugnostic calcareous spar.
78. 4.262, }
79. 4.254, } Rutile of distinct semi-metallic lustre, from Freiberg.
80. 2.989, }
81. 2.982, } Calcareous spar, from Schneeberg.
82. 3.263, Pyroxene of green color, from the greenstone in Voigtland.
83. 4.684, Axotomous iron ore, from Essex County, N. Y., America.
84. 4.211, Probably a new iron ore which forms with the above a uniform coarse granular mixture and resembling the magnetic iron ore.
85. 4.330, Flesh colored sulphate of barytes, from Freiberg.
86. 3.829, Yellow garnet of North America, identical with the aplome-garnet, from Franklin, N. J.
87. 3.336, A pyroxene distinctly prismatic, by the name of ferro-silicate of manganese, from Franklin, N. J. which bears great resemblance with the manganiferous pyroxene, from Sweden, but is not identical.
88. 3.443, }
89. 3.446, } Rosy calcareous spar, from Freiberg.
90. 4.030, }
91. 4.042, } Berthierite, from Freiberg.
92. 2.957, Tremolite, from New York.
93. 2.712, Polymorphous calcareous spar, accompanying the yellow garnet, from Franklin, N. J.
94. 5.144, Magnetical iron ore from the Uralian Mountains.
95. 3.581, Sideritic pyroxene or Jeffersonite, from N. J.
96. 3.582, The true Hedenbergit, from Tunaberg, Sweden, and appears to be in all its characters identical with Jeffersonite.
97. 2.940, Nordenskioldite, from Olonetz.
98. 3.323, The real Mesotype of Berzelius.
99. 2.789, Peach red calcareous spar, from Schneeberg.
100. 2.632, Pseudomorphous crystals of Gay Lussite, Mansfield.
101. 3.224, White hemidomatic pyroxene, from Finland.
102. 3.535, Sphene of changeable colors, from Tyrol.
103. 3.593, A massive brown iron ore, from Bohemia.
104. 4.626, Grey antimony, fine crystalized, from Freiberg.
105. 5.107, Zinciferous iron, from New Jersey.
106. 5.232, Micaceous iron, from Tyrol.

Art. X.—*Expeditious Mode of Manufacturing Vinegar, practiced in Germany;* by Dr. Lewis Feuchtwanger, of New York.

This method depends principally upon bringing the fluid, intended to be converted into vinegar, into contact with the ferment and atmospheric air, at a temperature of 100° F., in very thin layers, so that at the same time the menstruum may be deprived of its foreign matter, but not of any of its spirit and acid vapors.

The annexed drawing of an apparatus for manufacturing any quantity of strong vinegar, within twenty four hours, shall now be explained.



The principal part forms the *concentrating tub* A, resting on a pedestal about 1½′ or 2′ distant from the floor, which is 9′ high, at the lower end 3′ and above 3½′ in diameter, and provided with from seven to nine iron hoops. At the distance of 3″ or 4″ from the bottom there are some small holes *c*, *c*, ½″ or ⅜″ wide, and bored downwards and covered with iron gauze, for permitting the air to enter. 1″ above the bottom the glass or tin tube *g* is fastened, through a cork, and is bent a little upwards, in order to keep the liquor in the cask constantly at a certain height, and to prevent the tube from being stopped up by swimming splinters or sediment; but the orifice must be at least 1″ deeper than the holes *c*: this tube is to be connected with the recipient *b*, for the ready vinegar. On two boards, fastened within the concentrator with wooden screws, a

smaller tub of 4″ or 5″ in depth is placed, the bottom of which is perforated with small holes of ⅛″ wide and 1″ in distance, but quite smooth and plane. A wooden plug is put into each of those holes, and in such a manner that if a liquid is contained in the tub, it will only be allowed to pass dripping. This tub stands at 1″ distance from the wall of the concentrating tub. It is understood that all these parts have to be constructed of well soaked wood, and particularly those where the plugs have to fit, for otherwise the holes would swell on and prevent the passage of the fluid. Right above the holes *c, c*, a perforated sieve-like bottom is put, filled with washed beech shavings, or stalks of grapes. In order to close the concentrating tub, the following manner will be best—to fix a rim of sheet tin, 1″ broad and deep, for covering the staves, so that when nailed on, the cover will exactly fit into the stave, and when the same is provided with a sheet tin on its edge and wet leather, it is natural that the cover will only come as far as the rim, without touching the bottom of the staves. On the edge of the tub a wet strip of coarse linen is laid, where the cover is to rest on; the rim is filled with water, and the air is by these means cut off.

In order to observe the temperature in the concentrator, the bulb of a thermometer may be affixed, through a hole bored in the middle of the tub at *d*, and the scale may be fastened outside the tub. In order to effect a strong draught of air through the concentrator, without losing any of its vapors, another principal part, the *condensing apparatus*, is put in connection with the above, and consisting of three wooden tubes *h, i, k*, the width of which must be equal to that of the holes *c, c*. *h*, 1′ long, reaching in the hole of the cover, the joints are carefully stopped up with tow or linen. *i*, is rather ascending, (in order that the condensed vapors from it may be able to return,) through the wall of the vinegar room *k*, and is then connected with the self-opening part *l*, that in passing through the cooler *m*, to the small vessel *n*, the contents of which are to be filled back from time to time into the concentrator. It is understood that all the joints have to be well stopped up, and that fresh water has always to be kept in the cooler.

The third principal part is the filling apparatus; by boring at 3″ distance from the edge of the cover of the concentrator a second hole, which connects, by means of a leather tube, provided at both ends with tin tubes, the wooden cockscrew *g* and the small keg *p*, in air-tight manner.

For managing the manufacture of vinegar with full advantage, four such concentrators may be put into use, in a well floored room, provided with tight doors and windows, and from 12′ to 14′ high, which may be heated by air; the joints at the passage of the tubes through the walls of the room must be well stopped, and all four concentrators may be connected with one tube, coming from *l*, *m*, *n*, outside the room.

Before setting the apparatus into operation, all the parts belonging to it have to be well washed and boiled with hot water, the concentrators filled with birch wood shavings of 2′ long and ½‴ thick; these, well curled and previously boiled in water, are now put upon the perforated bottom, and soaked in strong vinegar; a second layer is now added, and likewise soaked in vinegar; and so continue, until the tub is full, without pressing them together. Now the small tub with the bottom provided with pins is put within, the cover fitted on and put in connection with the condensing apparatus, the vinegar room heated to 95° or 110° F., and the vinegar running from the shavings through the tube *g* is now thrown back with the addition of fresh ones to the same until they are fully impregnated; and these shavings, so acidulated, may be used for years, provided whiskey and water is employed as material for vinegar; other substances that contain slimy or other impure matters, will require the same to be renewed from time to time, and acidulated again. After the shavings have been acidulated, the filling cask *p* is supplied with the material, and the cocks *q* are turned, so that no more fluid can be admitted in the concentrator, to run at the same time through the sieve holes; and the fluid passes dripping through the bottom of the tub, extends itself over the shavings, runs slowly to the lower part of A in performing its object, and the sour liquor runs through *g* to *b*.

This product is by no means the ready vinegar, but it has to travel at least twice more over the journey; and the advantages are now manifest to work with four concentrators, and we may now for the first concentrator put altogether fresh materials for vinegar, with one third of the whole quantity to be added; in the second the produce of the first, with the second third of the additional whiskey; in the third, the produce of the second, with the last third of the additional whiskey, and the fourth may be used as a clearing tub, through which the produce or the vinegar obtained from the third concentrator may be running, without further addition for clearing. It is

but at the first operation of the concentrators that we require vinegar for the material, afterwards we may easily dispense with it, the shavings being sufficiently sour to take its place. Another advantage in having several concentrators is, that if the shavings of the first one should require to be cleaned or renewed, the process need not be interrupted, but needs only to be advanced, and the first has afterwards to take the place of the fourth as clearing tub. If the vinegar, after having passed through the three tubs, should not be sufficiently strong, the produce of the second is not all put in No. 3, but as much as will be equal to the additional whiskey; the like is done with the produce of No. 1; these three runnings are all thrown back into No. 1, as fresh vinegar material, and as we always add whiskey to the produce of 1 and 2, if all three casks are of equal size, there will then always be more vinegar material for 2 and 3, and it will be necessary, therefore, to bring the running of 3, if it should be sour enough, into No. 1.

Art. XI.—*Observations on Sulphurous Ether, and Sulphate of Etherine* (*the true Sulphurous Ether;*) by R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

It is known that when two parts, by weight, of sulphuric acid are distilled with one of alcohol, a yellow sulphurous liquid is obtained. Berzelius alleges, that when this liquid is exposed in an exhausted receiver over sulphuric acid and hydrate of potash, an oleaginous liquid remains, which he designates as "*oil of wine containing sulphuric acid, or heavy oil of wine.*"

This oil is, by the same author, described as being heavier than water, as having a penetrating aromatic odor, and a cool pungent taste, resembling that of peppermint. It is, in fact, the liquid which Hennel first analyzed as oil of wine, without, at the same time, mentioning the process by which it was procured. No doubt the difference between it and that procured by Boullay and Dumas, was in some degree, the cause of the discordance between his observation and theirs. According to Hennel, the oil of wine consists of an atom of sulphuric acid, and an atom of hydrocarbon: $\ddot{S}+4C+4H$. By the last mentioned appellation, this skilful chemist designates a compound consisting of four atoms of carbon, and four of hydrogen.

Serullas represents the oil in question as consisting of two atoms of the acid, two of hydrocarbon or etherine, and one of water.

To the hydrocarbon of Hennel (4 CH,) as the common base of all the ethers, excepting those lately alleged to have mytheline for a base; the name of etherine has been given; so that the heavy oil of wine may be called the sulphate of etherine: or, according to the formula of Serullas, $2\dddot{S}E+H$, it is a hydrous sulphate of etherine. It is, in fact, the only compound to which the name of sulphuric ether can be applied with propriety. The yellow liquid out of which it is procured, as above stated, may be designated as the ethereal sulphurous sulphate of etherine.

Another oil, lighter than water, resulting from the distillation of the ethereal sulphurous sulphate of etherine, from hydrate of lime, or from potash, is described by Berzelius as oil of wine exempt from sulphuric acid. Of this the odor is represented as disagreeable; and, though nothing is said of its taste, it is to be presumed that it differs from the heavy oil of wine in this respect, as well as in its odor and specific gravity.

Thènard alleges, that when the heavy oil of wine is heated with water for some time, a liquid swims on the water, which, if refrigerated by ice, will, within twenty-four hours, deposit crystals. The mother liquid he calls light oil of wine, while to the crystals he gives the name of concrete oil of wine. Hennel mentions his having obtained a similar product by the reaction of oil of wine with water, or an aqueous solution of potash; and treats the crystalline matter as the base of the heavy oil of wine, deprived of its acid; or, in other words, as his "hydrocarbon;" or, as above mentioned, etherine.

Considering how much has been written on this topic, I am surprised that I have met with no statements respecting the reaction of ammonia with the above mentioned ethereal sulphurous sulphate of etherine.

Since the year 1818, I have been accustomed to saturate the acid in that liquid by ammonia. The residue, being rendered very fragrant, and entirely freed from its sulphurous odor, by admixture with about twenty-four parts of alcohol, was found to constitute an anodyne, possessing eminently all the efficacy of that so long distinguished by the name of Hoffmann. When the residue, remaining after saturation with ammonia, was distilled in a water bath, ether came over, and left an oil which I was accustomed to consider as the oil of wine.

I had observed that in the process above mentioned, there was a striking evolution of vapor, which seemed irreconcilable with the

received opinion of the re-agents employed. Since the affinity between the ammonia and sulphurous acid is energetic, it did not appear to be reasonable to suppose, that a copious escape of the one should be caused by its admixture with the other; and it was no less improbable that the vaporization of hydric ether, in its natural state, could take place at temperatures so much below its boiling point as those at which this phenomenon was noticed. In order to ascertain the truth, I luted a funnel, furnished with a glass cock and an air tight stopple, into the tubulure of a retort, of which the beak was so recurved downwards as to enter and be luted into the tubulure of another retort. The beak of the latter passed under a bell over water.

Both retorts were about half full of liquid ammonia, and surrounded with ice. The apparatus being thus arranged, about a thousand grains of the ethereal sulphurous sulphate of etherine were poured into the funnel, and thence gradually allowed to descend into the ammonia in the first retort. Notwithstanding the refrigeration, much heat was perceptible, and a copious evolution of vapor, which, passing into the second retort, was there absorbed or condensed, none being observed to reach the bell glass. At the close of the operation, hydric ether, holding oil of wine in solution, floated upon the ammonia in the first retort, and pure ether, of the same kind, floated on the ammonia in the second.

The ammonia in both retorts gave indications of the presence of sulphurous acid, on the addition of sulphuric acid. From these results, I inferred that a chemical compound of sulphurous acid and hydric ether formed the principal portion of the yellow liquid, and might be separated by distillation. Accordingly, by means of retorts arranged and refrigerated as above described, I procured a portion of sulphurous ether, which boiled at 44°, and which, when agitated with ammonia in a bottle, produced so much heat and consequent vapor, as to expel the whole contents in opposition to the pressure of my thumb. By employing the same distillatory apparatus, I subjected 2150 grains of the ethereal sulphate of etherine to distillation, and obtained 726 grains of sulphurous ether, which boiled as soon as the frigorific mixture was removed from the containing retort. This being redistilled, as in a former experiment, so as to receive the product in ammonia, left in the retort five grains of oil of wine. The resulting ammoniacal liquid, saturated with chloride of barium in solution, gave a precipitate which, agreeably to the table of equivalents, contained 356 grains of sulphurous acid.

The residue of the 2150 grains of ethereal sulphate being subjected to distillation, raising the temperature from 95°, the point at which it had been before discontinued, to 140°, the product obtained by means of a refrigerated receiver weighed 602 grains. This was, of course, inferior in volatility to the first portion distilled; and, when redistilled, it was found to contain a small quantity of oil of wine. In fact, it appears, the boiling point of the ethereal sulphurous sulphate rises, not only as the ratio of the sulphurous acid lessens, but also as the proportion of oil of wine augments.

The residual liquid being exposed to the heat of a water bath at 212°; a very fragrant and well flavored oil of wine was evolved, and floated upon a quantity of water acidulated by sulphuric or sulphovinic acid.

Agreeably to another experiment, 1750 grains by weight, of the ethereal sulphurous sulphate of etherine, after washing with ammonia, gave 869 grains of an ethereal solution of oil of wine. This being subjected to distillation by a water bath raised gradually to 190°, there remained in the retort 148 grains of oil, beneath which there were a few drops of acidulated water. Agreeably to the result of several experiments, the ethereal sulphurous sulphate of etherine yields about half its weight of the ethereal solution of oil of wine. The quantity is always somewhat less than half when weighed; but the deviation is not greater than might be expected to result from the loss by evaporation, and the diversity of refrigeration employed in the condensation of the ethereal sulphurous sulphate, during the process by which it is evolved.

Under the expectation of procuring a sulphurous ether of a still higher degree of volatility, I associated with the apparatus usually employed in the process for generating hydric ether, a series of tubulated retorts, of which the beaks were recurved downwards in such a manner that the beak of the first communicated with a perpendicular tube, passing through an open-necked cylindrical receiver, so as to enter the tubulure of the second retort, of which the beak was in like manner inserted into a tube passing through a receiver in a third retort, and this communicated in like manner with a fourth retort. The second, third and fourth retorts, and the tubes entering them, were all refrigerated, the first with ice, the second with ice and salt, and the third with ice and chloride of calcium.

By these means, on subjecting to distillation in the first retort 48 ounces of alcohol of 830, and a light weight of sulphuric acid, be-

sides the ethereal sulphurous sulphate of etherine usually resulting from the process, and condensing in the first receiver, it was found that in the other retorts severally, there were liquids of various degrees of volatility. That in the last boiled at 28°, but the boiling points rose gradually as the quantity of the residual liquid diminished.

In order to ascertain the nature of the sulph-acids abstracted from the ethereal sulphurous sulphate of etherine by the ammonia employed, chloride of barium was added in excess to the resulting ammoniacal solution, until no further precipitate would ensue. The liquid having been rendered quite clear by filtration, soon became milky. By evaporation to dryness, and exposure to a red heat, a residuum was obtained which proved partially insoluble in chlorohydric acid, and by ignition with charcoal, yielded sulphide of barium. It appears, therefore, that a hyposulphate of barytes existed in the liquid after it was filtered; as I believe that the hyposulphuric acid is the only oxacid of sulphur which is capable of forming with barytes a *soluble* compound, susceptible, by access of oxygen, of being converted into an insoluble sulphate, and precipitating in consequence.

It must be evident from the facts which I have narrated, that the yellow liquid obtained by distilling equal measures of sulphuric acid and alcohol, consists of oil of wine held in solution by sulphurous ether, composed of nearly equal volumes or weights of its ingredients; also, that the affinity between the *ether* and the acid is analogous to that which exists between alcohol and water. The apparent detection of sulphuric acid in the ammonia, justifies a surmise, that the etherine distils in the state of a hyposulphate, which subsequently undergoes a decomposition into sulphurous acid and sulphate of etherine.

The liquid above alluded to, as resulting from the saturation of the ethereal sulphurous sulphate of etherine by ammonia, and distillation by means of a water bath gradually raised to a boiling heat, is a very fragrant variety of oil of wine. It differs from that described by Berzelius as the heavy oil of wine of Hennel and Serullas, in being lighter and containing less sulphuric acid. I have a specimen exactly of the specific gravity of water, and have had one so light as to float on that liquid. The oil of wine obtained by ammonia approximates, in its qualities, to the variety which Thènard describes as light oil of wine. The presence of sulphuric acid in a definite or invariable ratio does not appear requisite to the distinctive flavor or odor of oil of wine.

The heavy oil of wine treated by Hennel as sulphate of hydrocarbon, $2\dddot{S}+4CH$; and by Serullas as a hydrous sulphate of etherine, $4CH+2\dddot{S}+\dot{H}$; I have obtained, as above mentioned, by exposing the ethereal sulphurous sulphate of etherine, in vacuo, over the hydrate of lime, or potash, and sulphuric acid. This variety sinks in water, being of the specific gravity of 1.09 nearly; is of a deeper hue than the other, and of a smell less active, with a taste somewhat more rank. A specimen of oil thus obtained being subjected to the distillatory process, a portion came over undecomposed, leaving in the retort a carbonaceous mass. 14 grains of the oil which had not undergone distillation, and a like portion of the distilled oil, were severally boiled in glass tubes with nitric acid until red fumes ceased to appear; about 28 grains of pure nitre were added to each, some time before the boiling was discontinued. The resulting liquid was in each case poured into a platina dish, boiled dry, and afterwards deflagrated by a red heat. The residual mass being subjected to water, the resulting solution was filtered, an excess of nitric acid added, and then nitrate of barytes in excess.

The precipitate obtained from the distilled oil, weighed when dry, only nine and five-eighths grains, while that procured from the oil which had not been distilled, amounted under like circumstances, to fourteen and one-eighth grains. Ten grains of another portion, left for some time over liquid ammonia, yielded only seven-eights of a grain of sulphate.

About a drachm of Hennel's oil of wine was subjected to distillation with strong liquid ammonia; fourteen and a half grains came over, retaining the appropriate fragrance and flavor. This yielded, by the process above described, only two grains of sulphate of barytes. After all the water and ammonia had distilled, the receiver was changed, and fourteen grains of oil, devoid of the fragrance and flavor of the oil of wine, were obtained. This yielded one and one-eighth grains of sulphate. A carbonaceous mass, replete with sulphuric acid, remained in the retort.

Hennel states that when oil of wine was heated in a solution of potash, an oil was liberated which floated upon water, having but little fluidity when cold; and which in some cases, partially crystallized. When gently heated, it became clear, and of an amber color. The vapor had an agreeable, pungent, aromatic smell. This oil must have been pure etherine.

It is not improbable that this oil, which may be considered as devoid of sulphuric acid, is more or less liberated in evolving oil of

wine, according to the nature of the process employed; and that the oil alluded to by Thènard and those procured by me by simple distillation, ebullition, or distillation with ammonia or potassium, are mixtures of the etherine with its sulphate in various proportions. As it is well known that the odor of the essential oils is rendered more active by dilution, the livelier smell of the solutions may be consistent with a diminished proportion of the odoriferous matter.

Oil of wine cannot be distilled per se without partial decomposition, which does not take place below the temperature of 300. When subjected to the distillatory process, over potassium, at a certain temperature, a brisk reaction ensued, and the oil and metal agglutinated into a gelatinous mass. By raising the temperature the mass liquefied, and a colorless oil came over, which retained the odor of oil of wine. Meanwhile some of the potassium remained unchanged, and appeared within the liquid in the form of pure metallic globules. On pouring into a retort a portion of nitric acid, in order to remove the caput mortuum, ignition took place from the presence of the potassium.

Art. XII.—*Of the Reaction of the Essential Oils with Sulphurous Acid, as evolved in union with Ether in the process of Etherification, or otherwise;* by R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

Having mixed and subjected to distillation, two ounces of oil of turpentine, four ounces of alcohol and eight ounces of sulphuric acid, a yellow liquid came over, having all the appearance of that which is obtained in the process for making oil of wine, described in the preceding article. On removing, by means of ammonia, the sulphurous acid existing in the liquid, and driving off the ether by heat, a liquid remained, which differed from oil of turpentine in taste and smell, although a resemblance might still be traced. This liquid was without any sensible action on potassium, which continued bright in it for many weeks. It proved, on examination, to contain a small quantity of sulphuric acid. I ascertained, afterwards, that in order to produce these results, it was sufficient to pour oil of turpentine on the mass which remains after the termination of the ordinary operation for obtaining ether, and apply heat. Subsequently it was observed that when the sulphurous ether was removed by

heat or evaporation, without the use of the ammonia, the proportion of sulphuric acid in the remaining oil was much greater.

By subjecting to the same process several essential oils, I succeeded in obtaining as many liquids to which the above remarks were equally applicable. With some of the oils, however, similar results were, by this method, either totally or partially unattainable, in consequence of their reaction with the sulphuric acid being so energetic as to cause their decomposition before any distillation could take place. No product can be obtained by distillation with sulphuric acid and alcohol from the oil of cinnamon obtained from cassia. From the oils of sassafras and cloves, but little can be procured.

However, in one instance, by previously mixing the oil of sassafras with the alcohol, in the manner described in the account given of the first experiment with the oil of turpentine, I succeeded in obtaining, in addition to a small quantity of the heavy liquid containing sulphuric acid, a minute quantity of a lighter one, devoid of that acid, which burned without smoke, was insoluble in water, and very fluid. I am disposed to consider the liquid thus procured as a hydrate of sassafras oil, or sassafreine, as I would call it, being analogous to hydric ether.

The oil of sassafras, whether isolated or in combination, possesses a remarkable property, which, I believe, has not attracted sufficient observation; I mean that of producing an intense crimson color, when added, even in a very minute quantity, to concentrated sulphuric acid.

One drop of oil of sassafras imparted a striking color to forty-eight ounce measures of sulphuric acid, and appeared perceptible when it formed less than a five millionth part. This property was completely retained by the lighter liquid above described as procured from oil of sassafras.

I subsequently observed, that when sulphurous acid, whether in the form of sulphurous ether, in that of a gas, or when in union with water, was brought into contact with any of the essential oils (including kreosote,) which were subjected to the experiment, they acquired a yellow color, and a strong smell of this acid.

In the case of the yellow compound thus obtained from any of the essential oils which I have tried, if the sulphurous acid be removed by heat, the oil, by analysis, will be found to yield sulphuric acid. That some acid of sulphur remains in union must be evident, since

washing with ammonia will not entirely remove the power of yielding sulphuric acid; and the total absence of the sulphurous smell demonstrates that the sulphurous acid either enters into an intimate combination with the oil, or acquires oxygen sufficient to convert it into sulphuric or hyposulphuric acid.

Those essential oils which contain oxygen, are most affected by the action of sulphurous acid.

Both the oils of cloves and cinnamon, after admixture with sulphurous ether and subsequent distillation, gave, on analysis, precipitates of sulphate of barytes. In the case of cloves, the precipitate amounted to one seventh of the whole weight.

By distilling camphor with alcohol and sulphuric acid, I obtained a yellow liquid, which, by washing with ammonia and evaporation, in order to get rid of the sulphurous ether, yielded an oil. The oil, by standing, separated into two portions, one solid, the other liquid. The solid portion resembled camphor somewhat in smell, but differed from it by melting at a much lower temperature, becoming completely fluid at 175°.

I found that the essential oils of cinnamon and cloves possessed an antiseptic power, quite equal to that of kreosote, and that their aqueous solutions, when sulphated, were even superior to similar solutions of that agent.

One part of milk mingled with four parts of a saturated aqueous solution of the sulphated oil of cloves, remained after five days sweet and liquid, while another portion of the same milk became curdled and sour within twenty four hours. Having on the 2d day of July added two drops of oil of cinnamon to an ounce measure of fresh milk, it remained liquid on the 11th; and, though it finally coagulated, it continued free from bad taste or smell till September, although other portions of the same milk had become putrid. A half ounce of milk, to which a drop of sulphurous oil of turpentine had been added, remained free from coagulation at the end of two days, while another portion, containing five drops of pure oil of turpentine, became curdled and sour on the next day.

A number of pieces of meat were exposed in small wine glasses, with water impregnated with solutions of the various essential oils. Their antiseptic power seemed to be in the ratio of their acridity. The milder oils seemed to have comparatively little antiseptic power, unless associated with the sulphurous acid, which has long been known as an antiseptic.

In cutaneous diseases, and, perhaps, in the case of some ulcers, the employment of the sulphurous sulphated oils may be advantageous.

A respectable physician was of opinion that the sulphurous sulphate of turpentine had a beneficial influence in the case of an obstinate tetter.

Possibly the presence of sulphurous acid may increase the power of oil of turpentine as an anthelmintic.

Pieces of corned meat hung up, after being bathed with an alcoholic solution of the sulphurous sulphated oil of turpentine, or with solutions of the sulphated oils of cloves or cinnamon, remained free from putridity at the end of several months. That imbued with cinnamon had a slight odor and taste of the oil.

I am led, therefore, to the impression that the antiseptic power is not peculiar to kreosote, but belongs to other acrid oils and principles, and especially to the oils of cinnamon and cloves.

The union of sulphuric acid with these oils appears to render them more soluble in water: whether any important change is effected in their medical qualities by the presence of the acid may be a question worthy of attention.

I have stated my reasons for considering the ammoniacal liquid, resulting from the ablution of the ethereal sulphurous sulphate of etherine with ammonia, as partially composed of hyposulphuric acid. By adding to this ammoniacal liquid a quantity of sulphuric acid, sufficient to produce a strong odor of sulphurous acid, and then a portion of any of the essential oils; a combination ensued, as already described, between the oils and the sulphurous acid liberated by the sulphuric acid, so as to render them yellow and suffocating. The habitudes of cinnamon oil from cassia under these circumstances were peculiar. A quantity of it was dissolved, communicating to the liquid a reddish hue. The solution being evaporated, a gummy translucent reddish mass was obtained, which, by solution in alcohol, precipitated a quantity of salt, and being boiled nearly to dryness, re-dissolved in water, and again evaporated, was resolved into a mass having the friability, consistency and translucency of common rosin; but with a higher and more lively reddish color. Its odor recalls, but faintly, that of cinnamon; its taste is bitter and disagreeable, yet recalling that of the oil from which it is derived. Its aqueous solution does not redden litmus; nor, when acidulated with nitric acid, does it yield a precipitate with nitrate of barytes.

Of this substance ten grains were exposed to the process above mentioned, for the detection of sulphuric acid, and were found to yield a precipitate of 6.5 grains of sulphate of barytes.

It may be worth while to mention, that in boiling the sulphated oils with nitric acid, compounds are formed finally, which resist the further action of the acid, and are only to be decomposed by the assistance of a nitrate and deflagration. I conjecture that these compounds will be found to merit classification as ethers formed by an oxacid of nitrogen.

One of my pupils, in examining one of the compounds thus generated, was, as he conceived, seriously affected by it, suffering next day as from an over dose of opium. He also conceived that a cat, to which a small quantity was given, was affected in like manner.

I had prepared an apparatus with the view of analyzing accurately the various compounds above described or alluded to, by burning them in oxygen gas; when, by an enduring illness of my assistant, and subsequently my own indisposition, I was prevented from executing my intentions.

Art. XIII.—*Of Sassarubrin, a Resin evolved by Sulphuric Acid from Oil of Sassafras, which is remarkable for its efficacy in Reddening that Acid in its concentrated state;* by R. Hare, M. D., Professor of Chemistry in the University of Pennsylvania.

I have mentioned in the preceding article that a crimson color is imparted to concentrated sulphuric acid by its admixture with a minute portion of oil of sassafras. This color is due to a peculiar resin elaborated from the oil by its reaction with the acid under favorable circumstances. This reaction is attended by phenomena which are striking, and, in some respects, singular. If a mixture be made of equal parts of the oil of sassafras, alcohol and sulphuric acid, on raising the temperature to a certain point, the whole mass rises up in a resinous foam, of a beautiful color, between copper and purple, with a metallic brilliancy. In some instances, it has been partially forced out of the retort through the beak in a cylindrical mass, which acquired, on cooling, the consistency of pitch. This pitchy substance is a compound of the resin above alluded to and sulphuric acid, with which it forms a soluble substance, neutralizing its sourness to a certain extent. By steeping this subacid compound in

ammonia, straining, washing the residue with water, and desiccation, a brittle, tasteless resin remains, which is quite insoluble in water, but very soluble in alcohol and hydric ether.

The addition of this sassarubrin to concentrated sulphuric acid, produces the crimson color already mentioned as resulting from the presence in that liquid of a minute portion of oil of sassafras. I infer that the color is due to the evolution of sassarubrin, which has a bassic affinity for the acid, to which it owes its birth. The ethereal and alcoholic solutions of sassarubrin are of the color of a dingy white wine, but acquire a deep crimson when mingled with concentrated sulphuric acid.

Sassarubrin may be produced by the union of the acid and oil, provided it be moderated by refrigeration or dilution with water.

Without some precaution, the heat produced is sufficient to char the resin more or less. The reddening influence of the oils of cinnamon and cloves is due to the generation of resins analogous to sassarubrin.

To those resins the names of cinnarubrin and clovorubrin may be severally assigned. Cinnarubrin may be evolved by adding oil of cinnamon to equal parts of sulphuric acid and water, previously mixed and refrigerated, the temperature being subsequently elevated till the mass rises up in a foam; when the whole should be poured into a solution of pearlash, from which the resin may be extricated by a strainer. It is analogous to sassarubrin, but it is less efficacious in coloring sulphuric acid, and does not, like the former, impart to the sides of the containing glass a rich red color. Moreover, it appears to be partially insoluble in alcohol, and to retain sulphuric acid after being boiled with an alkaline solution.

I infer that a new series of resins may be evolved from the essential oils by their reaction with sulphuric acid; which, having a general analogy to each other, may still have discriminating characteristics, arising from the oils whence they may be derived.

ART. XIV.—*Meteorological Register kept at Matanzas;* by A. MALLORY.

Matanzas, March 4, 1836.

TO PROF. SILLIMAN.

Dear Sir,—I duly received your favor enclosing the scale of Mr. Dewitt's conical raingage, and the New York circular; and offer in return my meteorological observations, made at this place for the year 1835. The mean temperature has been considerably lower than in former years—the mean of 1834 being 79.27, and of 1833, 79. Humboldt makes it about 78, which I had thought too low. The month of February was remarkably cold—and November warmer than October. The summer months were cool, and January ranged rather high. I have been at considerable pains to verify the observation, *that water taken from a considerable depth would give the mean temperature of the country,* and find it true. I have made a series of observations upon the water taken from a well of the depth of one hundred and sixty feet, and find it gives a mean of seventy eight degrees. In fact the difference between summer and winter never amounts to a degree.

My barometrical observations were made with a new and very neat instrument, made by Pike & Sons of New York; but I am inclined to think it ranges a little too high; of that however you will be the best judge—you will observe that the fluctuation of the mercury is extremely small.

The hygrometrical observations were made with Saussure's hygrometer, and I believe show a degree of humidity rather greater than noted by Humboldt. These instruments were all kept at an elevation of twenty five feet above the level of the sea, and about three hundred yards from its border, with a free exposure from without day and night, and properly shaded from any undue reflection. The raingage was of the old fashioned conical shape, with receiver, stop-cock, and graduated scale. I preferred it to a cylindrical one made of glass, or to Dewitt's, as it loses nothing by evaporation, and the observation is made with little trouble, at *sunrise,* for the last twenty four hours, as were those made with the register thermometer. The windgage used was of my own construction, and answers well to show the comparative strength of the wind for the different months. It consists simply of a small windmill, the shaft of which

is enclosed in a box, and suspends a weight upon a small cylinder, which, of course, increases in diameter at every degree marked upon the dial, which is upon the outer surface, the whole adjusting itself to the wind by a tail or rudder. The days marked fair agree almost exactly with those of 1834, '3, being for the first of those years two hundred and thirty one, and the second two hundred and thirty two. The quantity of rain has been a fair average; the heaviest being the 10th of October, 3.63. The greatest change I have noticed has been in the number of days marked "south winds"—of those sultry winds, we had in 1833 sixty five days, and in '34 forty days, and the corresponding years thirty and thirty four north wind days against fifty of this year. To this we must mainly attribute the low range of the thermometer for the latter. The variable winds too have prevailed to a greater extent than usual.

My other occupations have prevented my making any consecutive observations upon the electrical state of the atmosphere; perhaps those days marked "thunder" may give you some idea upon that subject. The land breeze, which generally springs up between eight and twelve o'clock at night, has prevailed to about the same extent as usual. You will observe that the mean of three daily observations gives the same result within a fraction, as the mean of two extremes per register thermometer. I would therefore recommend the use of the latter in a climate like this, as being attended with far less trouble; the only objection is that the quicksilver in the mercurial tube, is apt to become deranged when the instrument has been long used.

At the time of the remarkable meteoric display in November, 1833, I did myself the honor of making to you some observations upon the subject. I have not yet learned whether they reached you.* I remain, sir, with high respect,

Your very obd'nt serv't, A. Mallory.

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* They were received, and are cited in Vol. XXV. p. 401.—Ed.

Meteorological Journal, kept at Matanzas, (Cuba,) for the year 1835, *in Lat.* 23° 2′ *N. Lon.* 81° 36′ *W., by A. Mallory.*

1835. Months.	THERMOMETER. Mean temperature at sunrise.	Mean temperature at 2, P. M.	Mean temperature at sunset.	Average of highest range per register thermometer.	Average of lowest range per register thermometer.	Aggregate of mean temperature each month.	Aggregate of mean temperature per register thermometer.	Mean temperature of falling rain water.	Maximum.	Minimum.	Range of thermometer.
Jan.	66.84	76.71	73.39	77.16	65.87	72.31	71.51	66.00	86	58	28
Feb.	62.32	73.41	69.89	74.35	61.14	68.54	67.74	56.00	84	51	33
March,	69.80	78.42	75.35	79.67	68.26	74.52	73.96	66.00	89	58	31
April,	72.60	83.50	79.30	84.77	71.90	78.47	78.33	70.50	90	57	33
May,	75.00	84.54	80.48	85.64	74.09	80.00	79.86	71.60	93	68	25
June,	76.20	84.93	80.17	86.33	75.66	80.43	80.99	74.00	90	73	17
July,	76.35	85.80	80.29	86.64	75.61	80.81	81.12	72.66	90	73	17
Aug.	77.06	85.03	81.67	86.54	76.74	81.25	81.64	71.66	90	74	16
Sept.	76.83	84.96	81.23	85.70	76.66	81.00	81.18	72.00	90	74	16
Oct.	72.84	81.03	77.42	81.55	72.13	77.09	76.84	69.00	86	63	23
Nov.	73.50	81.20	78.33	81.53	73.07	77.67	77.30	66.00	86	64	22
Dec.	66.74	77.48	73.84	77.87	66.00	72.68	71.93	67.00	82	55	27
	72.17	81.41	77.61	82.39	71.42	77.06	76.86	68.53	93	51	42

1835. Months.	BAROMETER. Mean height at sunrise.	Mean height at 2, P. M.	Mean height at sunset.	Average of three observations.	Maximum.	Minimum.	Range.
Jan.	30.10	30.09	30.12	30.10	30.26	29.93	33
Feb.	30.15	30.15	30.18	30.16	30.25	30.01	34
March,	30.13	30.13	30.16	30.14	30.33	29.98	35
April,	30 07	30.06	30.08	30.07	30.20	29.95	25
May,	30.06	30.07	30.09	30.07	30.16	29.97	19
June,	30.07	30.08	30.11	30.09	30.21	30.01	20
July,	30.07	30.08	30.11	30.09	30.22	30.00	22
Aug.	30.05	30.08	30.08	30.07	30.20	29.80	44
Sept.	30.00	30.01	30.02	30.01	30.14	29.81	33
Oct.	29.99	29.99	30.02	30.00	30.11	29.90	21
Nov.	30.06	30.08	30.10	30.08	30.17	29.94	23
Dec.	30.09	30.09	30.12	30.10	30.29	29.90	39
	30.07	30.07	30.10	30.08	30.35	29.81	54

1835. Months.	HYGROMETER. Mean humidity at sunrise.	Mean humidity at 2, P. M.	Mean humidity at sunset.	Average of three observations.	Maximum.	Minimum.	Range.
Jan.	86.58	70.35	78.93	78.62	95	58	37
Feb.	84.17	69.00	80.00	77.05	93	53	40
March,	85.80	70.35	79.77	78.64	96	57	39
April,	89.70	72.80	82.50	81.66	95	55	40
May,	90.58	72.26	84.77	82.53	96	57	39
June,	91.20	78.17	86.17	85.18	95	63	32
July,	90.64	81.45	87.45	86.52	96	66	30
Aug.	91.06	81.83	87.83	86.90	95	69	26
Sept.	91.40	80.63	87.60	86.54	95	68	27
Oct.	90.77	75.87	85.48	84.04	95	58	37
Nov.	89.03	73.03	83.80	81.95	93	56	37
Dec.	85.64	67.39	79.55	77.53	94	51	43
	88.88	75.26	83.64	82.59	96	51	45

1835. Months.	WEATHER. Fair.	Cloudy.	Rain in inches.	Rain in 100-ths.	Thunder.	Fog.	WINDS. East.	North.	South.	North East.	South East.	North West.	South West.	Variable.	Land breeze at night.	Anemometer. Mean force.	Highest range.	Lowest range.
Jan.	19	12	3	18	1	3	3	9	5	10	2	0	0	2	22	8.29	21	1
Feb.	20	8	0	77	0	1	5	11	0	7	0	1	0	4	19	10.21	18	2
March,	24	7	0	63	0	3	6	7	3	12	0	0	0	3	18	12 51	27	6
April,	26	4	1	92	1	2	1	1	3	18	0	0	0	7	27	10.37	24	2
May,	23	8	2	32	4	0	2	0	1	23	0	0	0	5	25	10.55	22	2
June,	11	19	5	35	14	0	0	0	0	9	0	0	0	21	24	7.96	17	2
July,	10	21	9	57	15	0	0	0	0	9	0	0	0	22	24	9.37	20	2
Aug.	15	16	11	50	7	3	2	0	1	13	1	0	0	14	22	9.51	30	0
Sept.	11	19	7	80	10	0	0	0	2	12	0	1	2	13	27	7.40	20	0
Oct.	25	6	7	47	2	2	3	10	0	18	0	0	0	0	19	8.86	25	2
Nov.	20	10	3	38	1	2	4	4	0	22	0	0	0	0	23	10.43	20	1
Dec.	25	6	1	40	0	3	4	8	2	12	0	0	0	5	29	7.51	17	0
	229	136	55	29	55	19	30	50	17	165	3	2	2	96	279	9.41	30	0

Art. XV.—*On the Elevation of Mountain Ranges.*

It is an old theory, that the lower rock formations are more easily determined than the upper and more recent; it being sufficient to examine a small portion of territory, in order to consider the remainder analogous in age and character. Those who still advance (not to say maintain) the opinion, and believe in good faith that a part, for instance, of the northern extremity of the Rocky Mountains is an index for their whole extent, even to the extreme south, are certainly far behind the age in the investigations of a science where advancements are as rapid as in geology. That no such sure analogies are presented appears probable from hypothesis, and more than probable from observation. European geologists recognize within the small extent of the Alps not less than three, and in the Pyrenees four distinct classes. The writer will now make a few remarks on causes which might produce so seeming a correspondence with so wide an actual difference.

If the earth contain, as is probable, a series of immense galvanic batteries, producing the results of electric and magnetic phenomena, the identity of the element being inferred; then it may be assumed that this principle, acting by such vast machinery, and on so grand a scale, is adequate to the explanation required. And this power, which extends with variations from south to north, and proves the accumulation of forces to be in that direction, might, in one age, by a sudden expansion of elements, throw up the precipitous barrier mountains of Chili; and in another, acting on different combinations, produce the gradual swell of the crust above in the rise from the valley of the Mississippi, to the summits of the same range in our latitudes. Thus it is not difficult to conceive that an extensive and continuous mountain range may present characteristics entirely dissimilar. That the accumulation of forces is in the direction of the line of no variation, and not simply at the point beneath the magnetic pole, is manifest, in as much as the attraction is towards the line, and not directly towards the pole. Thus in 1813, the declination of the needle at New Orleans was 8° east, and at Philadelphia 2° 27′ west. If it be supposed that the needles were directed to some point of attraction, it would necessarily be where these lines produced will meet, which places the magnetic pole much too far south. Therefore it is evident that the attracting power lay between

the two places, and that it acts in the same manner as the local attraction of iron mines in turning the needle from the direction of the pole.

At present the direction of the magnetic line differs from any of our mountain ranges ; but that it may some time have been the same is not irrational to conjecture, since during less than half a century (the seventeenth) its course so greatly varied, that the whole extent of the Atlantic intervened between its places at the first and last observations. What in the course of ages have been the causes to diminish the intensity of the power, if it be diminished, or repress it, if it only slumber ; what are the laws of its variations, and what phenomena it may yet present, are subjects far beyond the limits of conjecture. At least there, more than elsewhere, are indications of a stupendous, although quiescent force, to fix the attention of the philosopher; and future observations may open a new era for science, if any connection in results can be demonstrated, tending to the discovery of the action of a principle which has been considered one of the mysteries of nature "never to be searched out by man." Wide as appear the deviations, and far from being systematized as are the facts recorded, it is not to be supposed that the principle is out of harmony with the economy of nature, whose laws are as fixed in the wanderings of a comet as in the revolutions of a satellite. And whatever be the anomalies of a few years' observations, the persuasion cannot be resisted, that in the recorded history of many ages would be seen in this, only another instance of beautiful simplicity in the mechanism of nature.

That the elevations in many mountainous districts have proceeded from local causes, and not from the action of any such constant principle, is not to be doubted ; and these, it is supposed, present sufficiently marked characteristics to be distinguished by accurate observers. Such perhaps are the Alps, the Highlands of Scotland, and though several ranges of Europe tend towards the opposite or Siberian magnetic pole, yet they are in general limited or broken up ; and the most careless and unscientific would naturally refer them to agencies, combined or acting differently from those which produced the great mountain ranges of America.

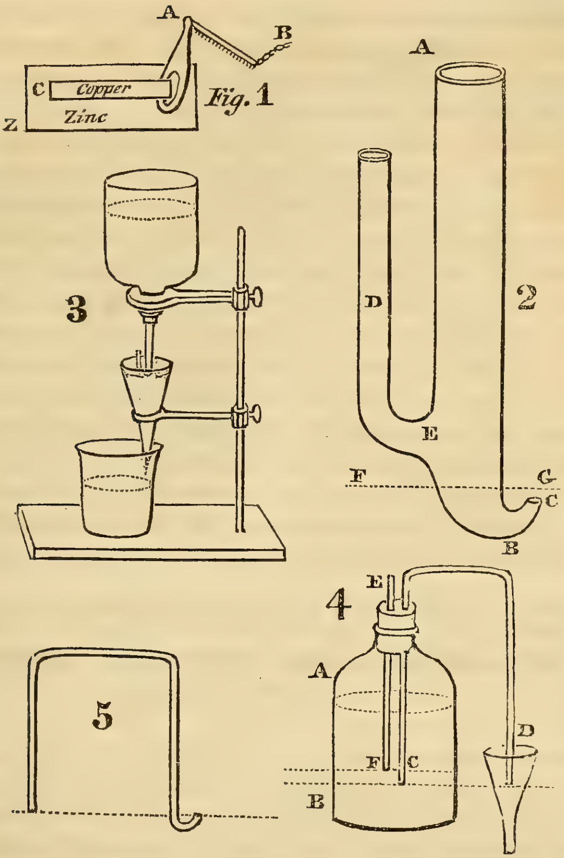
ART. XVI.—*Notes on Chemistry, &c.*; by J. W. BAILEY, Acting Prof. Chem. &c. U. S. Mil. Acad. West Point.

1. *Substitute for Frogs in Galvanic Experiments.*—Persons who may have occasion to repeat Galvani's experiment on the legs of frogs, will doubtless be pleased to hear of some substitute, which will enable them to dispense with the disgusting operations of cleaning, skinning, &c. which are necessary before the legs of a frog can be used. I find that a leg of the common *grasshopper* may be made to exhibit the muscular contractions; and as it appears to be easily affected by electricity, can frequently be obtained when frogs cannot, can be prepared at a minute's notice, and retains its irritability for five or ten minutes, it forms an excellent substitute.

The method of preparation consists merely in removing, with a sharp penknife, from each side of the thick part of one of the leaping legs, a portion of the skin, so as to expose the flesh; then by laying the under side of the leg upon a small piece of moistened zinc, and bringing a piece of copper in contact with the flesh exposed on the upper side, no motions will be observed until the copper also touches the zinc, when quick movements or jerks of the lower part of the leg will be seen, each time that contact is made. In Fig. 1, Z is the zinc, C the copper, A, B the part of the leg which will be observed to move.

2. *Washing Bottles.*—The admirable contrivances of Berzelius and Gay-Lussac, by means of which a substance to be washed upon a filter, may be supplied with water as fast as it is required, are not, I believe, so well known in this country, as their merits entitle them to be. I have used them with so much satisfaction, that I am induced to send the accompanying drawings and description; believing that they will be useful to some persons, who may be engaged in analysis or pharmaceutical preparations, and to whom they may be unknown.

Berzelius remarks, (Traité, Tome VIII, p. 270,) "Few modern instruments are so valuable to the practical chemist, as these simple washing bottles, since by means of them, the washing may be continued during all the time the operator may be obliged to be absent, and during his presence it requires no particular attention," except to see that channels do not form, which may lead the water off too rapidly.



The bottle used by *Berzelius* is fitted with a perforated cork, in which is inserted a tube of the form and *dimensions* represented in Fig. 2. A, B is a tube drawn out below and turned up, terminating in a small orifice C. The small piece of quill tube D communicates with A, B by the orifice E. A person tolerably skilled in the use of the table blowpipe, can make one of these in ten minutes.

The tube thus prepared is fixed, by means of a perforated cork, in a bottle containing water, and reversed over the filter, as in Fig. 3. so that the orifice C is placed just below the upper surface of the liquid in the filter. When this liquid falls below a line FG, the weight of the column of water from E to FG overcomes the capillary attraction, which retained a portion of water in the tube D; air

will consequently enter at E and water escape at C, thus the water in the filter will be kept at the level required. The pure water that issues at C displaces the solution below it, and the washing goes on in the most rapid and best manner possible.

Gay-Lussac's arrangement is equally simple, and may be prepared with even more facility than the preceding. The water is contained in a wide mouthed bottle AB (Fig. 4.) which is closed by a cork, through which passes a syphon with equal legs (CD) and a strait tube EF, whose lower orifice is a little above the level of the opening of the syphon. To facilitate the entrance of the air by means of this tube, it is cut off obliquely at bottom, as shown in the figure. The end D of the syphon being plunged into the liquid in the filter, the water will commence running cut, while air enters, bubble by bubble, through the tube EF. The water in the filter will not rise above the level of the orifice F.

The best shape of the syphon is shown in Fig. 5. in which the exterior opening is turned upwards. No practical chemist should be without one or the other of the above arrangements.

Art. XVII.—*On the Elevation of the Banks of the Mississippi, in* 1811; by F. C. Usher.

Princeton, (N. J.) July 20, 1836.

TO PROF. SILLIMAN.

Dear Sir—Having failed, while I was in New Haven, to comply with your request, that I should give to you on paper those statements that I made to you in the lecture-room, respecting the elevation of the banks of the Mississippi by the earthquakes of 1811, I will take the privilege of doing it now and sending it to you.

The statements which I shall make, I learned from the inhabitants of that place, together with what I saw myself. But having taken no notes, my memory being treacherous at that time, from ill health, and several years having elapsed since I was there, my statements will, of course, be liable to incorrectness. Notwithstanding, they shall be as near the truth as I can make them.

That you may the better understand my statements, I send with this as correct a map of the river there, as I can prepare.

In the fall and winter of 1811, (I believe,) those earthquakes took place. Their center was Madrid and Madrid bend. On both sides

1, Madrid.—2, Madrid Bend.—3, A swamp that was elevated.—4, A bed of coal under the river.—5, Land elevated.—6, Lakes formed: they are not all one, as represented in the drawing; I know too little to divide them: that there is a string of them there is all I know about it.—7, Land depressed.—8, This part of Madrid bend is now forming by the river.

of the river the earth cracked open, and streams of fire and red hot sand were thrown up. Some of these cracks were of considerable length and depth, and three or four feet wide. I saw some that were still four feet wider, and four feet deep, and extended, I was told, for miles. The shocks extended to all the surrounding country, for hundreds of miles, and were so violent as to shake down chimneys in many places, and even houses in Madrid and its vicinity. Madrid was then, and is still, a small place, and the surrounding region was then but thinly settled. That whole region (so far as I could ascertain) is bedded on quicksand; at least that which is near the river. This is proved by the sinking of wells, as well as by the fact that the falling of large timber shakes the earth to a great distance. This I have felt. Just below the surface of the river, at low water, is seen, as I was told, a bed of coal along round the Madrid bend; proving that the river has washed its channel through a bed of coal at that place. The bank marked by the figure 7, on which Madrid stands, was above the highest water mark before the earthquakes, but since

that, it has been subject to overflows to some extent; while the opposite side of the river was inundated by high water previous to that period, but since that it has not been known to be flooded. This is proved by the quantities of large cane that cover it, which is not the case with land that is flooded to any extent. That part of the Madrid bend marked 8 is to be excepted, as it is a bank now in the act of forming, by deposits from the river, a circumstance, I believe, almost peculiar to that stream. That part of the Madrid bend to which the remark respecting its being elevated applies, is that which is marked by the figure 5. But not only that part of the *Bend* marked with 5 was elevated, but also all that bank of the river where the figure 5 stands, until you get below the mouth of the river Obion, was raised at the same time. This elevation, however, was only a few feet. It, to some extent, obstructed the mouth of Reelfoot creek; also that of Obion river. This obstruction formed several lakes along back of this, where the figures 6 stand. It is quite probable that the land there was depressed, in some degree, in order to form these lakes. That these lakes, which are called Reelfoot and Obion, were formed then is proved by the old trees that were standing in them when I was there. The black spot by the figure 3, represents a swamp that has been raised. There are many such swamps, or rather sloughs, on that river, formed by the river forsaking its bed, and this is filled up first at either end, and then by degrees the other part is filled, by sediment carried into it by the floods, until at length it gets so that there is little else in it but a deep thin soft mud. Around the edges, which are higher and dryer, cypress has begun to grow, and by shooting its roots into the mud, it stiffens and dries it; as this takes place, small ones shoot up, and thus the trees environ those swamps. The larger ones are on the more elevated and dryer ground, and the smaller ones farther in. The swamp alluded to by figure 3 has this arch of cypress around it, the larger on the higher and the smaller on the lower ground, but beyond the influence of the cypress roots, it takes a gradual swell, rising higher in the center than elsewhere, but is very regular in its shape, looking as if when soft it had been pressed up from beneath, the center and softer parts rising the higher. This beautiful piece of land, for it is now high and dry, is covered with a uniform growth of young cotton wood. That this was one of those sloughs, and has been raised, is evident from the encircling cypress, its uniform shape, its being without cane in the midst of a cane brake, and the character, age, and uniformity of the trees that cover it.

James D. Dana Del.

Daggett Hinman & Co. Sc

ARGULUS CATOSTOMI

ART. XVIII.—*Description of the* ARGULUS CATOSTOMI, *a new parasitic Crustaceous animal,* (with figures.) By J. D. DANA and E. C. HERRICK, Members of the Yale Nat. Hist. Soc.

Read before the Yale Nat. Hist. Soc. June 2, and Aug. 4, 1836.

FOR our knowledge of the existence of the interesting animal which we have attempted to describe in the following paper, we are indebted to Mr. PHILOS BLAKE of this city. Early in the spring of 1835, this gentleman, whom we have always found ready to do a service to the cause of science, very kindly brought a specimen for our examination. This was accidentally destroyed before it had been fully investigated, and nothing further was done concerning the matter for that year. During the past season however, through the attention of the Messrs. BLAKES, and of several of the intelligent workmen engaged in their establishment, we have been liberally supplied.

A slight examination sufficed to show that the animal was closely related to that singular crustaceous parasite, which has attracted so much deserved attention, the *Argulus foliaceus* of JURINE, Jr.* The resemblance is so great that a hasty observer might conclude that the two are specifically identical; but after considerable study we are convinced that they are not. The correctness of this result, we hope to make apparent in the following pages.

The animal before us has been found at various times in the waters of Mill river, near Whitneyville, just below the fall at the manufactory there established. We have discovered none above the fall, but have been told that for a mile above, they are occasionally seen. It may not be irrelevant to mention that the tide-water of New Haven harbor flows up as far as the fall, so that the stream here has a large admixture of sea-water. It infests the fish here called the *Sucker.* The fish evidently pertains to the genus *Catostomus* of LE SUEUR, a monograph of which is given by him in the Journal of the Academy of Natural Sciences of Philadelphia, Vol. I, (8vo. 1817.) We cannot satisfactorily determine whether it is his *C. Bostoniensis* or *C. communis,* and are somewhat inclined to think that on further examination they may prove varieties of one species.

* The elaborate memoir of this author contained in the *Annales du Muséum d'Hist. Nat. de Paris,* 4to. tome VII. (1807,) has been our chief source of information concerning this species.

We were at first informed by several persons, that the parasite was found adhering to the outside of the fish when taken from the stream, but our own experience has never furnished a solitary case where this was the fact. We have universally detected it within the branchial cavities; usually on the operculum or gill-cover, and not on the substance of the gills. On immersing the fish in a vessel of fresh water, the Arguli desert their habitation, and after swimming about a few moments, often attach themselves to the anterior part of the fish, but never, as we could discover, for the purpose of feeding. Not unfrequently they also attach themselves to the sides of the vessel, and there remain many hours. This parasite has hitherto been discovered in the Sucker only: and we therefore call it the Argulus Catostomi, a name which cannot be inappropriate even if the animal should hereafter be found on other fish. The *Argulus foliaceus,* according to all the accounts we have seen, is never observed on the gills, but always on the exterior of the fish.

The body is covered for the most part by a shell so transparent that the principal organs below may easily be seen. The shell is nearly circular, somewhat broader transversely, slightly convex, with the clypeus extending a little beyond the general curvature. Posteriorly, it is divided into two broad lobes by a deep sinus, which gradually widens from its origin and extends as far as the line of junction between the first and second pair of natatory legs, leaving free the three latter joints of the abdomen. The shell is membranous and flexible; above glabrous. Its color is a light sea-green. The border of the shell and a small spot over each pair of antennæ are highly diaphanous. *Beneath,* the duplicature of the shell forms a wide band around the marginal portions, and leaves open a large reniform area on each side, and also another open spot of an irregularly circular form about the central parts of the wings of the shell. The wide marginal band is thickly set with minute reflexed spines.

The *eyes* as viewed from above, present twelve or thirteen dark reddish-brown facets, disposed in two concentric curves on a grayish convex receptacle, surrounded, except on the interior side, by a series of colorless facets.

The *antennæ* are situated in front of the eyes. The *anterior* pair is short and stout, two-jointed; basal joint broader transversely;—terminal joint nearly at right angles with the first, gradually tapering from a broad base, and ending in a large, brown corneous recurved

spine. This joint is hollow and contains a retractile spine of a brown color, capable of being projected into the terminating spine of the joint. From the middle of the posterior surface arises a jointed transparent process directed outward, extending beyond the main branch of the antennæ and terminated by three or four terminal transparent spines. This process is also furnished with a spine near its extremity.—The *posterior* pair of the antennæ is one third longer than the anterior, to which they are at base closely approximate. They are four-jointed, slender and diaphanous. The basal joint is large and sub-cylindrical, with a few minute spines on its posterior basal portion ; second joint one third the diameter of the first, with a few spines at its apex. Similar spines are observed on the apex of the first, which is one half the length of the preceding. Apical joint half the penultimate in length and diameter, terminated by three or four transparent spines. From the base of the first pair of antennæ arises a short, fleshy cone, directed backwards and downwards, having at its apex a stout, corneous tooth. The insertion of the muscles moving the antennæ may be observed near the base of the sucker.

The *organs of manducation* are complex. The anterior organ is a sucker, inserted in a three-sided membranous transparent retractile sheath, having free motion in any direction from its insertion in the fleshy parts below. While at rest it is directed forward and extends to the base of the antennæ. When the sucker is retracted within the sheath, a long ligulate muscle is observed lying loosely on the right, extending from the upper part of the sucker to the parts below its base.

Below the insertion of the sucker arises a convex oval mass (Figs. 1 and 4,) containing the rest of the mouth apparatus. It has a motion to some extent in every direction. Its lower half is covered by a lip, or thin transparent veil, capable of a backward movement; its upper limits are marked by the line *aba′*, (Fig. 4.) At *b* is a conical fleshy protuberance, inserted on the interior surface of the lip, and extending a little beyond its upper limits. Anterior to this lip lies transversely a bony arch (*cc′*,) of a brownish yellow color, curved forward and giving off obliquely downward on each side two bones, connected by a membrane. The extremities of this arch are gradually lost in the parts above. This arch is the lower limit of the membrane that covers the anterior portion of the oval mass. This anterior membrane is connected laterally with a slender bone

de, *d'e'*, which near the center of the sides of the oval mass (at *e*) curving suddenly inward and downward and at the same time enlarging tends to the base of the maxillæ. This bone at its angle *e* forms an ear-like projection to the oval mass. On each side of the center arises a curved, corneous and slightly colored maxilla (*f*, *f'*, Figs. 4 and 5,) which extends forward beneath and beyond the arch; the broad inner edge of each is serrated. An indistinct line near the apex appears to separate a short apical joint. These maxillæ approach at their extremities and are each connected at their base with one of the forks of a long, narrow, furcated bone *g*, which extends outward and as far forward as the attachment of the sucker sheath to the body, where it appears to be loosely connected with the surrounding muscles. The other fork of this bone is connected with the lateral bones before described as tending towards the base of the maxillæ after forming an ear-like projection. Between and connected with the maxillæ near their base, are two horizontal united processes, (*h*, Fig. 5,) which become visible on the retraction of the lip.

The maxillæ are capable of a slight motion back and forth in connection with the ear-like projections, which is effected by means of muscles extended nearly in the direction of the bones just described, and inserted near the anterior part of the base of the suction feet.

Between the two maxillæ laterally, the bony arch above, and the lip below, appears the orifice of the mouth, (above *b*, Fig. 4.) Beyond the maxillæ is frequently observed an internal longitudinal fissure, the opening of which is always accompanied with a retraction of the lower lip. On withdrawing this lip, and forcibly severing and uplifting the bony arch with the membranes, and the maxillæ with the long narrow bones to which they are attached, a second set of organs, similar to the first, presents itself. The maxillæ of the inner mouth, which may, for distinction, be called the *inner maxillæ*, are in shape, situation and structure, like the outer. They are dimly seen from without, just in front of the external maxillæ, (Fig. 4.) The longitudinal fissure above described appears to be situated in the upper membranes connected with the inner mouth, and extends forward from the bony arch of the inner mouth between the maxillæ. In endeavoring to trace analogies between this mouth apparatus and that of the more highly organized Crustacea, we are led to believe that the sheath of the sucker represents the *labium*, which may be supposed to be greatly elongated, and by the union of its lateral

margins to become tubular; and that the enclosed spicula represents the mandibles. The part which we have called the lower lip, is analogous to the *languette;* and the maxillæ with the long bones thereto attached are not unlike these organs as usually observed.

In the Argulus foliaceus the entire oval mass, which we have above described, is assumed by Jurine to be the heart; which we are compelled to consider a total error. The palpitation, or alternate contraction and dilatation, which he speaks of, appears to us nothing more than the motion of the maxillæ, which just before death often becomes incessant, and in the instance mentioned by him was probably caused by the "alcoholic asphyxiation."

The anterior legs are short, hollow, flexible cylinders, containing four tumid membranes attached near the center of these legs at the bottom and extending up along the sides. By means of these the animal is enabled to exhaust the cavities and thus attach itself to its prey. The extremity terminates in a broad, circular, horizontal rim, with a margin nearly entire, provided with about eighty bony rays, each composed of eleven joints, (Fig. 6.) When the animal is nearly dead, this rim assumes a vertical position, and from the relaxing of the membrane appears to have a crenated margin.* These legs in their natural position are at right angles with the body and consequently the lower portions are concealed by the terminating border. On fig. 1, may be seen lines proceeding from between the base of the anterior antennæ which probably mark the limits of a muscle connected with these legs.

The prehensile legs arise below and on each side of the mouth, and are six-jointed. The thigh or second joint, is short, massive and irregular, and its posterior margin is occupied by three broad and flat teeth, with interstices about equal to half the average width. These teeth are irregularly quadrilateral with rounded angles. In this respect this species differs from the A. foliaceus, in which there are four narrow, acute, and incurved teeth about the base of this joint.

On the lower surface is a triangular, subconvex elevation, covered with papillæ. The third joint gradually tapers towards its apex, where it is papillose; the fourth joint is shorter than the third, and

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* Jurine's figure of this rim or disk errs in exhibiting it in the vertical position as that which appears during life: this is never observed except when the powers of life are nearly exhausted.

flattened on the under side, which is also papillose; the fifth is similar to the fourth, and about one third its length; the terminal is provided with two apical hooks.

The natatory or branchial legs arise in a series on each side of the abdomen. The three anterior pairs are composed each of *three*, the fourth of *two*, large fleshy joints, and are terminated by two long pinnulæ. Along the posterior edge of the second and third joints of the two anterior natatories, is a ciliated ridge; a corresponding ridge is observed on the third joint of the third pair, while on the second joint there is substituted a ciliated lamina: similar laminæ are situated on both joints of the fourth pair, which on the basal joint is large and cultriform, and covers the termination of the abdomen. The edges of the pinnulæ are provided each with a row of transparent plumose ciliæ. These rows are inclined to one another at an angle of about 120°, and in the usual position of the pinnulæ, one is invisible, it being directed towards the shell.

The outer pinnula of the first pair of natatories is three-jointed; (Fig. 7.) the first joint occupies nearly its whole length, the other two are very short and destitute of ciliæ: at the apex are two minute setæ. Along the centre of these pinnulæ runs a dark vessel, which is probably connected with the branchial ciliæ. At the base of the pinnulæ of the first and second pairs of legs on the upper side, arises a *recurved* pinnula, composed of two nearly equal joints, and ciliated like those above described.* During life, the legs are extended a little forward, and the pinnulæ are wholly covered by the shell. At death they are inclined backward, as in Fig. 9.

The abdomen is somewhat depressed and composed of four joints, each of which gives rise to a pair of natatory legs; the fourth joint extends mostly beyond the shell. From its extremity proceeds a broad rounded lamina, bilobate posteriorly, and provided with two minute projecting ciliated plates, at the base of the terminal sinus. This caudal lamina or tail has an entire and diaphanous margin, and is destitute of ciliæ.

Extending from the termination of the abdomen, and partially covered by the cultriform plates on the fourth pair of natatories, are two narrow laminæ, (Fig. 1. ss.) near the base of which are the organs

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* In the Argulus foliaceus, the first outer pinnula is not stated to be articulated; neither is mention made of any joints in the fleshy part of the natatory legs, or in the recurved pinnulæ.

of reproduction. Two oval yellowish vesicles or *pouches*, (Fig. 1. rr.) are situated in the tail on each side of these laminæ.*

The anal orifice is situated between the laminæ at the base of the caudal sinus: the fæces are conveyed through a duct lying along the central line of the tail, and pass out on the lower side of the laminæ.

The *brain* is situated near the upper surface of the shell over the sucker, and at its posterior extremity is composed of three connivent elliptical masses, of which two are nearly longitudinal, and the anterior transverse. The central portion between these elliptical masses, is of a deep reddish black. From the brain, nerves are given out, which proceed down the abdomen, and supply the natatory legs; below, another nerve is visible, passing to each eye.

Posterior to the *oval mass*, and within the body, are observed four imbricated laminæ, of which the three anterior are cordate. Long slender cords appear to proceed from the sides of each lamina, and extend into the natatory legs; those from the *first* lamina extending to the *first* pair of natatories, &c. These cords have much the appearance of muscles. No blood is seen circulating in them, though it is very discernible, in a broad backward current over them. This current appears to arise from beneath the imbricate laminæ, and thus renders it probable that they have some connection with the heart, if they do not actually compose it. The blood is limpid, and holds suspended numerous egg-shaped particles, (Fig. 8,) and is propelled by distinct pulsations, which occur about once in a second. The length of these particles is about $\frac{1}{4000}$th of an inch, and the greatest breadth about $\frac{2}{5}$ths of the length. The current above referred to, cannot be traced along the abdomen; but in the tail there are distinctly apparent two parallel currents, which diverge at the base of the terminating sinus, and curving around the transparent margin, return into the body. Numerous subordinate currents ramify throughout the tail, dividing it into minute areolas.

In an upper view of the animal, a strong current is observed above the heart, proceeding towards the brain, (Fig. 9. r.) where branches are given out to the antennæ and eyes. The antennary current, after reaching the antennæ, is soon lost in the surrounding parts of the shell. Just below, however, on each side, appear minute branching

* All the specimens we have seen (about thirty) have been provided with these vesicles. It is possible that we have not seen any of the male sex.

vessels, in which the blood has a returning course. These minute vessels discharge themselves in a broad channel, (Fig. 9. n.) which enters the body near the base of the abdomen.

The ophthalmic current, which is most distinctly seen in an under view, curves at the eye and passes backward, enters the suction legs, is seen again between those legs and the prehensile, and also for a short distance posterior to the latter, after which it disappears.

Another current (Fig. 9. k.) goes out laterally, a short distance behind the brain, to the anterior margin of the reniform area before described. It passes just within the exterior margin of the same area, and returns into the body after a final course along the inner edge of each lobe of the shell.

Near the base of the abdomen arises a fourth current, which running downward and outward is diffused through the lower portions of the shell, and probably returns into the body by the same current with the preceding.

It is impossible to trace the passage of the blood into the branchial legs. It is probable that the above currents, after returning to the body, pass to these legs for aeration, and thence to the heart to be again diffused throughout the animal. Pulsation is frequently observable along the whole abdomen, and often with great distinctness in the tail. The currents of blood are not apparently confined within vessels of definite limits.

The pairs of muscles by which the animal moves the various parts of the shell are four. The *first*, or that acting on the clypeus, arises each side of the brain and accompanies the antennary blood vessels. The *second* (oo) arises just below the base of the preceding, and is directed outward and upward. Between this and the third is a suture, which is apparent when either muscle is in action. The *third* accompanies the current of blood (k) which passes to the anterior part of the reniform area. The *fourth* accompanies the current (m) which flows to the posterior portion of the shell, and is attached near the central part of this portion. Several of these muscles are easily mistaken for the courses of the blood. The muscles of the legs are for the most part visible, and are given in the plate. Two muscles extend from their insertion, near the base of the prehensile legs, on each side of the abdomen, and appear to cross near its extremity.

The entire abdominal region below of the gravid female, is occupied by eggs. The number of eggs which may be laid by one female, cannot be stated with certainty. On the 18th of June, 1836,

one of them deposited on the sides of the vessel in which she was contained, about one thousand five hundred, and a considerable mass of eggs still remained within. The eggs have an oval form, are white when first laid, but soon become of a dirty yellow, and finally assume longitudinal crenated ribs. They are attached to each other and to the object on which they are placed, by a glutinous substance, and are disposed end to end, in single rows of about four or five, sometimes however of ten or fifteen. These rows have a somewhat promiscuous arrangement.

Thirty five days after deposition, the young animal appeared, through a longitudinal fissure in the shell, the eyes and some of the darker parts having been visible about ten days previous. Its length is $\frac{1}{36}$ of an inch, and the general shape of the shell an oval, somewhat broader anteriorly. Beyond the shell, extend the three terminal joints of the abdomen, ending in a broad tail, with two terminal elongated protuberances, from each of which proceed three unequal setæ.

The *eyes* are of a reddish brown color, and proportionally much larger than in the adult animal. The anterior pair of antennæ have a general resemblance to the corresponding pair in the perfect animal, except that here the posterior branch is proportionally much larger and constitutes the chief part of the organ.

Behind these arise two pairs of oars; the anterior pair have a basal joint in common with the posterior antennæ which extend downward and outward from the oar. Jurine seems to have erred in supposing this pair independent of the oar. The oars are slender and cylindrical, extending beyond the shell. From each proceeds a pencil of plumose hairs; the number of these, in the anterior pair is four, in the posterior, three. These hairs may be made to approximate or diverge at pleasure. The posterior pair may possibly represent the maxillæ which are wanting; they appear to arise from the origin of the long bones which in the perfect animal are found connected with the maxillæ.

The sucker extends beyond the anterior margin of the shell and is distinct, but the organs contained in the oval mass below are extremely obscure.

The suction legs are replaced, as is the case with the A. foliaceus, by a pair of prehensile legs, which end each in a spine provided with a sheath in which it commonly lies, (fig. 11.) The next pair are somewhat like the prehensile in the perfect animal, which legs

they represent. The next pair (representing the first pair of natatory legs,) terminate in two branches, one of which is jointed, while the other ends in two setæ. The three following pairs of natatories are not developed. Instead thereof are three protuberances on each side of the abdomen, ending each in two setæ.

The internal organs of the abdomen as observed are exhibited in fig. 10.

The larve is quite active, and by means of its oars swims with great agility. Out of a thousand, none lived more than four or five days, probably for the want of appropriate nourishment. During that time they suffered no change.

From the structure of the mouth as described in the preceding article it is obvious that the name of the order (Siphonostoma) to which the animal must be referred, is not truly applicable, since the siphon is a small part only of the apparatus for manducation. It seems to be a connecting link between the Xyphosura and Siphonostoma, and may perhaps hereafter become the type of a new order.

A plain man, and quite unversed in comparative anatomy, on looking at our Argulus with a lens of moderate power, remarked that it was nothing but a young *horse shoe.* The animal to which he referred is the *Limulus Polyphemus,* (commonly called *horse shoe* or *horse foot,*) found so abundantly on our coasts. Although our opinion does not altogether coincide with his, yet we think that between the two, many analogies may be traced.

In the Limulus the relative sizes of the clypeal and the thoracic segments are in inverse ratio to the same parts in the Argulus; in the former, the clypeus occupying a large portion, in the latter, but a small portion, of the shell. The prehensile legs of the latter correspond in the number and relative size of joints, and in the dentation of the haunches, to the posterior pair of manducatory legs* of the former. The semicircular membrane of the former, which is composed of a pair of united legs, represents the tail of the latter. It resembles it in containing near its origin, two seminal pouches and in being furnished with two collateral lamellæ at its terminal sinus; as well as in its general form. The natatory legs of the latter are the analogues of the branchial legs of the former; their number is however smaller by one, unless we consider the anterior pair as composed of two in union, which opinion receives much support from the fact that in the larve this organ is double.

* In this pair the number of joints is six; in the four preceding pairs, one less.

In endeavoring to demonstrate, in the Argulus, the *eleven* pairs of parts or organs which are commonly found posterior to the antennæ, in all the Crustacea, we proceed thus:—as reckoned above, there are, including the tail, six pairs of branchial members; next, two pairs of prehensile, considering the suction legs as such; then, two pairs of maxillæ; and lastly, a pair of mandibles transformed into the siphon. The bony arch, situated on the medial line, is not unlike the bony wall which in other Crustacea forms the anterior border of the buccal aperture.

J. V. Thompson, the author of many curious discoveries concerning the metamorphosis of the Crustacea, has published* a short notice of an anomalous parasite which he names *Sacculina Carcini*, found by him on the *Carcinus Mænas.* This parasite he considers identical with the *Argulus armiger* of Müller, figured by Slabber in plate 6 of his *Natuurkundige Verlustigingen*, (Haarlem, 1769–78)—a species we cannot find recognized in any work since the time of Müller, except in the *Encyclopedie Methodique*, (*Insectes*, Art. *Argule.*) Mr. T. has not seen it in the mature state, and it is therefore at present impossible to ascertain its relations to the *A. foliaceus* or *A. Catostomi.* The larve appears to be totally destitute of all organs of manducation. We hope to hear further respecting so remarkable an animal.

The buccal apparatus of the *Pandarus alatus*† has, as from its similarity of habits might be expected, some resemblance to that of the *Argulus*, but the siphon when at rest, lies in a reverse direction. An extended comparison between the trophi of these two genera, would be of great interest.

We are well aware that the foregoing account of the *Argulus Catostomi* is not complete. Many particulars of its habits and metamorphoses, together with many important details of anatomy are yet to be discovered. Some of these deficiencies we hope to supply at a future day.

New Haven, Conn., October, 1836.

EXPLANATION OF THE PLATE.

Fig. 1. Under view of the *Argulus Catostomi.* Seminal pouches r, r.
Fig. 2. Posterior branch of the first pair of antennæ.
Fig. 3. Termination of the second pair of antennæ.

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* Entomological Magazine, (8vo. London,) Vol. 3, p. 452—456. April, 1836.

† Described and figured by H. Milne Edwards, in Annales des Sciences Naturelles, (8vo. Paris,) tome 28, p. 78—86, and plate 8.

Fig. 4. Mouth apparatus—*aba′* upper limits of lower lip—*cc′* the extremities of the transverse bony arch—*de*, bone which curves at *e* and passes towards the base of the maxilla—f, f′ maxillæ, the lower extremities of which are beneath the lower lip.

Fig. 5. g, g′ internal bones connected with the maxillæ f, f′ and situated in the animal as here represented.

Fig. 6. One of the jointed bony rays of the suction legs.

Fig. 7. First pair of natatory legs, exhibiting the two terminating pinnulæ, of which one is jointed at its extremity, and also the recurved pinnula, jointed near its middle—also the ridges of hairs which in the animal are represented near the posterior margin of the legs. These hairs are perspectively foreshortened.

Fig. 8. Particles observed in the circulating fluid.

Fig. 9. Back view of the *Argulus Catostomi*, the right hand side exhibiting the circulation, the left hand, the muscles which move the shell, and the organs below as seen through the transparent parts above—i, i, the antennary current—n, the return current of the same—h, the ophthalmic, (seen most distinctly below)—k, k, k, and m, lateral current whose direction is pointed out by the arrows they contain. The arrows in the tail mark the direction of its currents—z, z, the junction of the shell with the abdomen. On the left, i, o, k, m, represent four muscles by which the animal moves its shell. Three of the blood vessels above pointed out, i, k, m, are in the direction of these muscles—i, i, move the clypeus—o, a portion of the shell between the clypeus and x—k, and m, the lateral and posterior parts of the same.

Fig. 10. Under view of the young of the *Argulus Catostomi*.

Fig. 11. Termination of the legs corresponding to the suction legs in the perfect animal, the spine partly separated from its sheath.

Art. XIX.—*A Translation of a memoir entitled "Beitrage zur Lehre von der Befruchtung der Planzen,"* (Contributions to the doctrine of the impregnation of plants;) by A. J. C. Corda: published in the 17th volume of the Nova Acta Physico-medica Academiæ Cæsar. Leopold.-Carol. Naturæ Curiosorum. Breslau and Bonn, 1835;—*With prefatory remarks on the progress of discovery relative to vegetable fecundation;* by Asa Gray, M.D.

Read before the Lyceum of Natural History, New York, Oct. 24th, 1836.

The last volume of the transactions of the Imperial Acad. Naturæ Curiosorum, just received through the kindness of the learned Nees Von Esenbeck, the president of that society, contains a brief memoir on the impregnation of plants, which will doubtless be read by the botanist and the physiologist with more than ordinary interest. M. Corda, in the paper referred to, gives an account of an original and highly curious series of observations on the structure and development of the ovules, and the mode in which impregnation is effected, in the natural family Coniferæ. The memoir is illustrated by numerous admirably executed figures.

The comparatively recent discoveries of Amici, Adolphe Brongniart, Mirbel, and Brown, having invested the subject of vegetable reproduction with unusual interest, I was naturally led to study the memoir of M. Corda with particular attention. The researches here communicated to the scientific world are the last, though by no means the least, of a series of discoveries on this recondite subject, which, taken together, may be safely said to form the most important contribution ever made in vegetable physiology. I had prepared a translation of this paper for my own private use; but, supposing that it would be generally interesting, I have been induced to lay it before the Lyceum. I have thought it advisable, moreover, to premise a cursory account of the progress of discovery respecting the fecundation of flowering plants, for the purpose of rendering the subjoined memoir more generally intelligible to those who are not particularly conversant with the present state of botanical science.

Impregnation, in flowering plants, essentially consists in the production of an embryo or rudimentary plant within the *ovule*,* or body destined to become the seed. Since the office of the stamens in vegetable reproduction was indicated by Grew and Ray, and afterwards clearly established by Linnæus, it has been well known that unless some grains of pollen come in contact with the stigma, impregnation does not take place. The seed-vessel may, indeed, continue to grow and ripen in the absence of pollen, and the contained ovules attain the size, texture, and (the embryo excepted) the structure of well-formed seeds; but in such cases a rudimentary plant, which is the essential part of the seed, is never produced. Respecting the immediate origin of the embryo in the animal kingdom, it is well known that three different hypotheses, being all that the nature of the case admits of, were advanced at an early period. These several hypotheses have been extended by analogy to the vegetable kingdom. According to one view a germ furnished by

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* The reader is supposed to be acquainted generally with the structure of the ovule, a subject upon which the limits of the present remarks will not allow me to enter, except to indicate the sources from which the requisite knowledge may be obtained, viz: R. Brown's paper on the genus Kingia, with remarks on the structure of the unimpregnated ovule; *Mém. sur la génération et le développement de l'embryon, &c.* by Ad. Brongniart in the 12th vol. of the Annales des Sciences Naturelles; and, particularly, *Nouvelles recherches sur la structure et le developpement de l'ovule végétal,* by Mirbel, in the 17th vol. of the same work. The substance of these memoirs will be found in the more recent elementary botanical works.

the pollen is supposed to be deposited in, and nourished by the ovule: according to another, the germ is thought either to pre-exist in, or to be originally formed by the ovule itself, and that it is merely excited into action by an influence derived from the pollen: and according to a third, the embryo is conceived to result from the union of a germ furnished by the pollen with another produced by the ovule.* It is hardly probable that we shall ever possess the means of absolutely proving the correctness or demonstrating the fallacy of either of these hypotheses; but it may be remarked that the first mentioned view, which was advanced at an early period, is the most difficult to be reconciled either with the phenomena of hybridity or with the manifest analogy that exists between seeds and buds; and yet recent discoveries have again rendered it the more probable hypothesis.

Soon after the discovery of the office of the pollen, several attempts were made to explain the manner in which this substance acts upon the stigma. Some of the earlier writers, such as Geoffroi and Malpighi, seem to take it for granted that the entire grains of pollen which fall upon the stigma pass down the style quite into the ovary; and Moreland† suggested that the grains even penetrate the ovules and become the embryo. The latter author, who was, I believe, the first to extend the hypothesis of Leeuwenhoek to the vegetable kingdom, inquires "whether it be not more proper to suppose that the seeds which come up in their proper *involucra*, are at first like unimpregnated ova of animals; that this farina (*pollen*) is a congeries of seminal plants, one of which must be conveyed into every ovum before it can become prolific; that the stylus in Mr. Ray's language, the upper part of the pistillum in Mr. Tournefort's, is a tube destined to convey these seminal plants into their nest in the ova; that there is so vast a provision made because of the odds there are whether one of so many shall ever find its way into and through so narrow a conveyance." He then proceeds to record several circumstances; which are, in his opinion, confirmatory of this view; especially the manifestly tubular style of the *Crown Im-*

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* The latter hypothesis is adopted by Ad. Brongniart with much confidence in his memoir above cited.—" Dans cet espace . . . . un ou quelques-uns des granules spermatiques s'unissent probablement à d'autres granules fournis par l'ovule pour donner naissance au petit globule, premier rudiment informe de l'embryo," &c. *Ad. Brongniart in Ann. Sci. Nat.* 12, *p.* 254.

† *Some new Observations on the Parts and the Use of the flower in Plants;* by Samuel Moreland.—Philosophical Transactions, Vol. 23, (1703.)

perial and some other plants, the cavity of which he erroneously considered to lead directly into the seed-vessel. This cavity, however, only exists in some compound styles, being formed by the cohesion of three or more simple styles so as to form a hollow cylinder, and it consequently does not communicate with the interior of the ovary. Moreland also observed the micropyle (the vestige of the foramen of the ovule) in peas and beans; he supposed it to be a perforation produced by the entrance of a grain of pollen, which, having fallen down the tube into the ovary, had at length entered the ovule and become the embryo or seminal plant.

It was discovered, I think by Needham, that when grains of pollen are moistened or thrown upon water, they usually burst with violence and discharge the slightly viscous and turbid fluid contained within. To this fluid the immediate agency in impregnation was attributed by Linnæus and contemporary botanists. Two opinions, however, have prevailed respecting the mode of its action upon the ovule; some writers supposing the fluid itself to be conveyed down the style to that organ, while others conceived that a peculiar action excited upon the stigma was transmitted to the ovule by a kind of sympathy. The former view appears to have been adopted by Linnæus.* The latter was sustained by Grew and several succeeding philosophers. Our actual knowledge upon this subject was, however, confined to the simple fact that the application of the pollen to the stigma was essential to the fertilization of the ovules, all the information we possess respecting the action of the pollen after it has reached the stigma being of very recent date. The earliest of a series of highly curious discoveries on this hitherto mysterious subject was announced in the year 1823. A few remarks on the structure of pollen will form a necessary introduction to our account of these interesting researches.

The pollen, when examined by a moderate magnifying power, is seen to consist of a multitude of grains of some regular form, which is uniform in the same species, but often differing widely in different plants. It has been satisfactorily proved that these grains are composed of two coats, of which the exterior is rather thick and nearly inelastic, while the inner is an exceedingly delicate and highly ex-

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* Generationem vegetabilium fieri mediante pollinis antherarum illapsu supra stigmata nuda, quo rumpitur pollen efflatque *aurem seminalem*, quæ absorbetur ab humore stigmatis, &c.—*Linn. Phil. Bot. ed Stockholm.* 1751. p. 91.

tensible membrane. The cavity is filled with a fluid, which, under a powerful lens, appears slightly turbid, on account of a vast number of minute granules which float in it. The existence of an inner lining to the pollen-grains was ascertained at an early period, first by Needham and afterwards by Koelreuter, and, although since doubted, the correctness of their observations has lately been abundantly confirmed by the admirable researches of Ad. Brongniart and Mirbel. An account of some recent observations by the last named author is appended to his incomparable memoir on Marchantia, where he has also given a representation of the two coats.

A magnifying power of two or three hundred diameters reveals the existence of two kinds of granules in the fluid of the pollen-grain. The larger kind, which are also the fewer in number, have been particularly examined by Ad. Brongniart and Brown, whose researches, made about the same time and wholly independently of each other, coincide in almost every particular.* These granules are peculiar to pollen, and have been detected in every plant that has been submitted to examination. They differ in shape in different plants, but are uniform in the same species. The following is extracted from the account of these granules given by R. Brown, as they appeared in the pollen of the plant which he first submitted to examination. "This plant was *Clarkia pulchella*, in which the pollen-grains, taken from the anthers when completely developed but before their dehiscence, were filled with particles or granules of a size varying from the 4000th to about the 5000th of an inch in length, their form being intermediate between cylindrical and oblong, slightly flattened perhaps, the extremities being rounded and equal. While examining the form of these particles floating in a drop of water, I observed that many of them were evidently in motion. Their movements were not confined to a mere change of place in the fluid, as manifested by modifications in their relative position, but there was frequently a change of form in the particle itself; and several times a contraction or incurvation was perceived near the middle of a particle on one side, accompanied by a corresponding convexity on the opposite side. In some instances the particle was seen to

* These granules were discovered and described by Needham as long ago as the year 1750. *He even suggests that they penetrate to the ovule and form the embryo.* This is not the only instance in which the observations and suggestions of this author, after having been doubted or left in obscurity for nearly seventy years, have been recently confirmed, or rendered extremely probable.

revolve upon its longer axis. I was convinced, from repeated observations of these movements, that they are produced neither by currents in the fluid nor by gradual evaporation, but that they pertain to the particles themselves."* The same phenomena were observed both by Brown and Brongniart, in a great number of plants of different families, with the exception that the change of form in the particles themselves was less evident when these are oval or oblong in shape, and perhaps never apparent when they are spherical. It is worthy of remark, moreover, that Ad. Brongniart observed that the somewhat cylindrical granules of the pollen of several Malvaceous plants repeatedly exhibited a double curvature like the letter S. The movements of the larger granules are never rapid, and are frequently very slow. The same motions were observed in the granules of pollen taken from recently dried specimens, and also from those that had been kept for several days and even for some months in weak alcohol; but in pollen taken from dried specimens which had been preserved, some twenty, and others more than one hundred years, Dr. Brown found that, although the movements of the *molecules* or smaller particles were unaffected, those of the larger granules were scarcely evident, and often not at all apparent. According to Brongniart's observations, the movements of granules from fresh pollen were suddenly checked when put into alcohol.

The smaller particles, or *molecules* as they are termed by Brown, were first observed by this distinguished naturalist in the pollen of *Clarkia pulchella*, mingled with the larger granules already described; and they have since been detected in a great number of species. They differ from the larger granules not only by their size, which varies from the 15,000th to the 30,000th of an inch in diameter, but also in their form, which is always spherical, and in their movements, which are oscillatory and extremely rapid. These molecules were also observed in the powder of the so-called anthers of mosses and other flowerless plants by Brown, who found, moreover, that their motions were equally vivid, whether taken from the living plants or

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* *An account of microscopical observations made in the months of June, July, and August*, 1827, *upon the particles contained in the pollen of plants, and upon the general existence of active molecules in organized and inorganized bodies;* by R. Brown. I re-translate from a French translation, published in the Annales des Sciences Naturelles, Vol. 14, p. 341; not having been able to procure the original pamphlet, which was only printed for distribution among the friends of the author, and is now very scarce.

from specimens preserved in an herbarium for more than one hundred years. Continuing these investigations, he discovered similar particles, endowed with the same motions when suspended in a fluid, not only in all forms of vegetable tissue, but also in every inorganic substance examined, except those soluble in water or whatever fluid was employed for their suspension.*

In the year 1823, Prof. Amici, in examining with his powerful microscope some grains of pollen on the stigma of the common purslain, (*Portulacca oleracea*,) observed that the grains had projected from some part of their surface an extremely slender tube, which was found to consist of the inner lining of the pollen-grain, protruded through a rupture of the external coat. Amici published an account of his discovery in the 19th volume of the *Atti della Società Italiana*, whence it was extracted in the second volume of the *Annales des Sciences Naturelles*. About three years afterwards, these tubes were observed in several plants of different families by Ad. Brongniart, to whose admirable memoir, published in the 12th volume of the work just cited, we are indebted for the earliest and most complete account of the manner in which they originate and act upon the stigma.

When grains of pollen fall upon the stigma they are retained either by the hairs with which this organ is often provided, or by its humid and slightly viscous surface; they slowly absorb this moisture, and, after an interval varying from some hours to a day or more, the outer coat opens by one or more points or slits, through which the highly extensible inner membrane protrudes like a hernial sac, and is slowly prolonged into a delicate tube. The diameter of these tubes does not exceed the 1,500th or 2,000th of an inch, and of course a powerful microscope is required for their examination. In some plants the grains appear to open at a determinate point, and in numerous instances each one produces two or three pollen-tubes. This happens in the genus *Œnothera*, and perhaps in all the plants of that tribe, in which the triangular grains open usually by two, and some-

* For further particulars respecting this curious subject, the reader is referred to the original memoir of Dr. Brown, above cited; and also to some additional remarks on the same subject, which may be found in a French dress in the 29th vol. of the Annales des Sciences Naturelles.—Respecting the formation of pollen, the reader should consult the memoir of Ad. Brongniart, above cited, p. 21, et seq.; R. Rrown's paper on Rafflesia, in the 12th vol. of the Transactions of the Linnæan Society of London; and the supplement to Mirbel's memoir on Marchantia polymorpha in the Nouvelles *Mémoires du Muséum.*

times by three of the grains, and produce as many tubes. The pollen of several plants, however, (particularly in the Cucurbitaceæ,) is known to protrude its inner lining from a great number of points; and Amici has even seen as many as twenty or thirty incipient pollen-tubes arising from a single grain. Commonly, however, each simple and globular grain of pollen produces but a single tube, which makes its appearance from whatever portion of the surface may chance to be placed in contact with the stigma. This production can hardly be considered as a mere protrusion of the inner lining of the grain, since the length commonly attained by the tube is greatly disproportionate to the original size of that membrane. It should, perhaps, be regarded as a growth of the inner coat, excited by the fluid which moistens the stigmatic surface. Yet it is hardly probable that this fluid exerts any specific and peculiar agency in the production of the pollen-tube, since it has lately been stated* that a mixture of sulphuric acid and water causes their production in the same manner as the stigmatic surface itself, only with greater promptitude. M. Brongniart has also seen them arise from grains of the pollen of Nuphar and some other plants, when floating on water, without having been in contact with the stigma. Usually, however, water is so rapidly imbibed that the grains suddenly burst so as not to admit of their production. The stigma of one plant, moreover, is known to excite the same action in the pollen of different species, and even of plants belonging to different families. Thus, Dr. Brown applied the pollen-mass of a species of Asclepias to the stigma of an Orchideous plant, and found that these tubes were produced as readily as when left in contact with the stigma of the plant from which the pollen-mass was taken.

The tubes, thus produced in contact with the stigma, penetrate its substance, not, however, by means of any peculiar channel, but by gliding between the cellules and along the intercellular passages which abound in the tissue of the stigma and style. M. Brongniart was able to follow them only for a moderate distance into the tissue of the style, where he thought that they terminated, and, opening at the extremity, discharged the fluid and floating particles of the pollen-grain. He conceives that these larger particles pass along the intercellular spaces into the placenta, and thence into the mouth

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* I have met with this statement in the article *Botany*, of the Library of Useful Knowledge, but I do not know on what authority it rests.

of the ovules. Prof. Amici* has, however, recently announced that he had in several instances traced the pollen-tubes themselves quite into the cavity of the ovary; from which he infers that the immediate contact of this body with the mouth of the ovule takes place whenever impregnation is effected.

In the autumn of the year 1831, Dr. Brown read before the Linnæan Society of London his highly interesting memoir on the *Organs and mode of Fecundation in the Orchideæ and Asclepiadeæ;* which has since been published in the last volume of the transactions of that society. It is unnecessary for our present purpose to indicate the several curious and important results of the investigations of that sagacious botanist, relative to the structure and impregnation of these two families. He followed the course of the pollen-tubes, in several plants of both orders, from the stigma to the placenta, and in a single instance traced, in an Orchideous plant, some tubes or vessels of equivocal nature quite into the aperture of the ovule. Dr. Brown remarks that these tubes had been noticed in the style and ovary of these two families many years previous to his observations, viz. in Orchideous plants by Du Petit-Thouars as early as 1816 or 1818; and by the late Mr. Elliott in Podostigma, (a genus of Asclepiadeæ,) as stated in the first volume of the *Sketch of the Botany of South Carolina and Georgia,* published in 1817. Mr. Elliott adds that Dr. Macbride (since deceased) had observed the same *fibres* or *cords* in the style of some species of Asclepias. We have no reason to believe that in any of these instances the true origin or office of these cords was even suspected.

In a short communication addressed to the editor of the *Linnæa,* dated Nov. 1827, and published in the fourth volume of that work, Dr. Ehrenberg gives an account of his observations on the structure of the pollen-masses in Asclepiadeæ; and states that each grain is furnished with a cauda or cylindrical tube of great length, directed to the point where the membrane of the pollen-mass opens; which appendage he considers as analogous to the *boyau,* or pollen-tube of Amici and Brongniart.† He supposes that these processes exist previously to the application of the pollen-mass to the stigmatic surface, which is doubtless incorrect; but Dr. Brown has observed in

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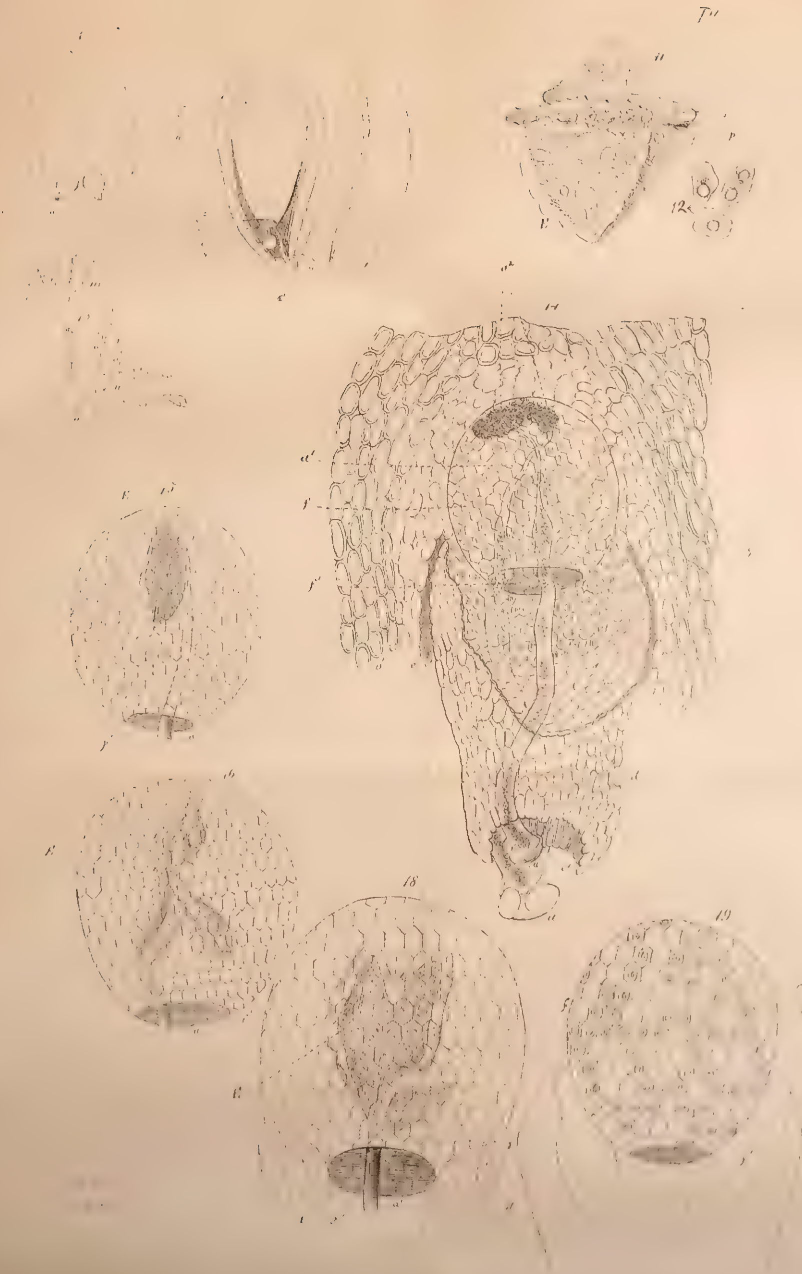
* Extract from a letter from Prof. Amici to M. Mirbel, dated 3d July, 1830, and published in the 21st vol. of the Annales des Sciences Naturelles.

† *Linnæa. IV.* p. 95.

Pl. 2

From nature by Corda
Copied on transfer paper
by
J. W. Bailey
U.S.A.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19

this family the curious fact, that the application of one portion of the pollen-mass to the stigma causes the production of a pollen-tube from every grain of the mass.

I am not aware of any important addition to our knowledge on this subject during the interval between the publication of Dr. Brown's paper, and the date of the following memoir of *M. Corda;* which was read before the Imperial Acad. Naturæ Curiosorum, in Sept. 1834, and published in the Transactions of that society for the year 1835.

M. Corda inferred, from previous observations, that the pollen-tubes usually extend quite to the mouth of the ovules; consequently it became a highly interesting subject of enquiry to determine their further course. In prosecuting the subject, he was induced to examine the mode of fecundation in the Coniferæ or Fir tribe; in which the naked ovules, impregnated by immediate contact with the pollen, would naturally be supposed to offer great facilities for such investigations. The subjoined memoir is accordingly restricted to an account of the development of the ovule, and the mode of impregnation in the order Coniferæ.

Although the following translation will, I trust, be found substantially to embody the ideas of the author, my very slight acquaintance with the German language offers a sufficient explanation for whatever errors may have been committed. I was obliged to undertake this labor myself, since no one unacquainted with the structure of the ovule, could properly translate a memoir of this kind, however conversant with the language in which it is written.

Contributions to the doctrine of the Impregnation of Plants; by A. J. C. Corda.

All our views respecting the impregnation of plants have been entirely remodelled since the discovery of pollen-tubes by Amici; the former hypotheses having been sufficiently refuted by the curious discoveries of Brongniart, no less than by the assiduous and ingenious researches of Robert Brown. Since the appearance of Robert Brown's writings, and his visit to Germany, the results of his investigations are so generally known, that I consider an historical account of them superfluous; and will only mention that according to my own knowledge, Robert Brown has traced the pollen-tubes quite to the placenta; thus partially confuting the opinion of Brongniart

as to the deposition of an *aura seminalis*, (the contents of the pollen-tubes.) He, however, did not see the entrance of the pollen-tubes into the micropyle of the ovules. I had already seen the pollen-tubes penetrate quite into the cellular tissue of the placenta in *Hyacinthus*, *Himatoglossum* and *Orchis maculata;* but it appeared to me impossible, in this instance, to follow them farther.

In the winter of 1833–34, I frequently repeated these observations on the Hyacinth, and saw the penetration of the pollen-tubes into the placenta, without touching, however, the micropyle of the ovules. During my residence in Berlin, I had the honor of showing to his Excellency Freihern von Humboldt, and to Professor Kunth, this penetration of the pollen-tubes into the placenta. At the same time I was zealously engaged in researches upon the Cycadeæ and Coniferæ; and concluded about the time of their flowering to continue my experiments on the fecundation of the latter family, since it bears naked ovules, and we can every year obtain large quantities of ripe seeds. I was convinced that the penetration of the pollen-tubes through the micropyle must certainly take place in this family, but was far from imagining that such an interesting and important series of investigations would arise out of the subject.

By a careful examination of the cavity of the ovule in the fruit of a *Pinus* with a lens, or even by a close inspection with the unassisted eye, grains of pollen may be perceived reposing in its orifice, (Tab. 42, fig. 1, *a*.) In this manner the pollen-grains of *Larix* are represented by Nees von Esenbeck in his *Genera Plantarum*, (Vid. a. a. O. fig. 7.) If we lay open the cavity in the scale, by taking off the covering, (Tab. 42, fig. 3, *b*) removing at the same time the primine of the ovule which is originally adherent to the scale, (Tab. 42, fig. 3, *c*) we observe the pollen-tubes, (a. a. O. a.) which have reached from the pollen to the endostome (Tab. 42, fig. 3, e^2) of the secundine (*d*.) But often the grains of pollen fall through the exostome, (Tab. 42, fig. 3, e^1) and rest upon the orifice of the secundine, (Tab. 42, fig. 3 and 4, *d*) i. e. the endostome, (e^2) or they sometimes fall into the cavity of the secundine, as may be perceived in fig. 4, of Tab. 42, in fig. 14, of Tab. 43, and in fig. 21, a a^1 of Tab. 44.

So far my observations demonstrate that the pollen-tubes penetrate into the micropyle and the endostome; but in explaining their further course it becomes necessary to recur to my researches upon the ovules of Coniferæ. My observations differ by no means from

those of the great Englishman,* nor from the investigations of Mirbel; but as we have to follow the course of the pollen-tubes into the innermost cavity of the ovules, it is necessary to be acquainted with their structure.

Robert Brown was, we know, the first to demonstrate the pistillate flower in Coniferæ and Cycadeæ to be a naked ovule. This naked ovule is situated in a bottle-shaped cavity of the inside of the scale, which is directed downwardly and inwardly (Tab. 42, fig. 3, *b*) and its first or outer coat (*primine*) (Tab. 42, fig. 3, *c*; Tab. 43, fig. 14; and Tab. 44, fig. 22, *ccc*) is coherent with the inner surface of the cavity; therefore both together form the exostome, (Tab. 42, fig. 3, and 44, fig. 21, *e′ e′*.) But this intimate union only exists in the early state; they are gradually loosened by the ripening of the seeds, and at length the primine is completely separated from the walls of the cavity. While the inner side of the wall of the scale is being separated, a portion of the integuments of the scale tears loose, and appears like a wing half surrounding the base of the ripened seed, (Tab. 44, fig. 30, *x*. and 33.)

During the ripening of the ovules, the exostome closes more and more, the primine gradually thickens, and becomes harder and almost corneous, and finally appears as a hard covering to the seed, (*testa vel membrana externa seminis.*)

In an earlier stage, while the primine of the ovule is yet coherent with the surface of the cavity in the scale, we find in the upper part a free empty space, (Tab. 42, fig. 3, Tab. 43, fig. 14, and Tab. 44, fig. 21 and 22, *c′ c′ c′ c′*) into which the summit of the (*zapfenartigen*) secundine (Tab. 42, fig. 3, 4, 5, Tab. 42, fig. 14, and Tab. 44, fig. 21—29) projects. This free space (which in the scale is under the ovule, the latter being suspended) is limited by the connexion of the secundine to the nucule and primine, (Tab. 43, fig. 14, *g*.)

The secundine (Tab. 43, fig. 14, *dd*) is a rather firm, hollow body, (*zapfen*,) which is connected with the nucule at the base, and terminated by its orifice at the other extremity. The nucule (*ff*) of the ovules of *Pinus* is situated within the secundine, with which it is coherent only at the base. An exception which I have not previously observed in any other ovule. The secundine is originally a short conical body, in which a small, roundish, obscure spot makes

* Robert Brown, *Botanicorum facilè princeps.—Trans.*

its appearance, (Tab. 44, fig. 23, *f*); the future nucule is first perceived by a metamorphosis of matter and form taking place at the base of the almost homogeneous cavity. In this state it is nearly impossible with our instruments to ascertain its internal structure; for it appears like a scarcely congealed fluid. At a later period we perceive the nucule (*f*) occupying the base of the secundine, (Tab. 44, fig. 24,) in a state of greater development, and already exhibiting cellular texture. A membranous layer of the parenchyma of the secundine begins to separate at this time, appearing as a nearly transparent narrow border. About this time the endostome (*e'*) begins to be perceptible.

In the third and fourth state of the ovules, the secundine and nucule increase simultaneously; but a conical wart (Tab. 44, fig. 25—28) occupies the endostome and projects from the cavity; this appearance might easily lead to the erroneous supposition, that there was in this case an union of two membranes. The cellular membrane and the substance of the nucule (Tab. 44, fig. 25—28) have now attained considerable firmness and the cells have become opaque.

In the fifth state we perceive a well defined orifice to the nucule, and the cellular substance of the secundine being filled with starch, the ovule itself appears firmer. The sac of the nucule is composed of large six-sided cells, (Tab. 43, fig. 19,) originally filled with a turbid fluid, which congeals into a somewhat crystalline matter, (Tab. 43, fig. 20, *s*.) In the cell (*r*) this crystalline matter appears in the form of somewhat wax-like, firm, and yellowish polyhedral bodies, (*s*.) The cells which contain this congealed matter are connected with each other, so as to form on the outer surface of the nucule a beautiful net work, (Tab. 42, fig. 7, Tab. 43, fig. 14, 15, 19, 20, and Tab. 44, fig. 23—29.)

The nucule itself is about half the size of the secundine, and is situated at the base of the latter; and while the perforation of the endostome is incomplete, the opening of the nucule, which we call the *embryostome*, is merely indicated. In the further growth of the ovule previous to impregnation, we perceive the embryostome to enlarge considerably and to connect itself with the endostome through the cavity of the secundine.

This brief account appears to me sufficient to enable us to follow the course of impregnation through the secundine into the interior of the ovule.

We left the pollen-tubes when they had reached the endostome of the secundine. In order to ascertain how far the pollen-tubes penetrate, I made a longitudinal section of an ovule, while yet enclosed in the scale, in such a manner (Tab. 43, fig. 14,) that a great part of the secundine was removed, while the nucule (*f*) and the embryostome (*f′*) were left entire; by this means the course of each pollen-tube (*a′*) was manifest from the endostome (e^2) to the very bottom of the nucule (a^2.)

I saw the pollen-tubes pass through the orifice of the secundine to the mouth (the embryostome) of the nucule (*f′*); pass through the latter into the cavity of the nucule, where they become somewhat attenuated, or suddenly enlarge, (Tab. 43, fig. 14, *a′*,) and empty their contents as a turbid, originally amorphous, fluid mass.

After this deposition, the pollen-tube still remains in the endostome, the embryostome, and the cavity of the nucule, appearing as a slender, empty, and transparent *bag*. The deposited matter is soon perceived to become organized, and the sac of the embryo (Tab. 43, fig. 15, E) is formed, which increasing rapidly in size, often appears flaccid, or thrown into folds on one side or the other; and its contents are still turbid. It is still fixed to the pollen-tube, as we have represented in Tab. 43, fig. 15—18, E *a′*.

During the growth of the sac of the embryo a peculiar change takes place in the minute polyhedral bodies which occupy the cells of the tissue of the nucule; these particles become fluid or disappear as it were by absorption, until the cells again appear perfectly clear and pellucid, (Tab. 43, fig. 18.)

At this period there may be found, especially in *Pinus Abies*, more than one embryo-sac in each ovule; there are ordinarily two or three placed side by side,* (Tab. 42, fig. 7, 10, 11.) These embryo-sacs are found, on examination, to consist of an integument (Tab. 42, fig. 11, *p*) loosely enclosing a kernel (*q*.) The kernel has a gelatinous consistence, and is composed of large, oblong cells (Tab. 42, fig. 12,) mixed with fine knotty threads, to which minute drops of a fluid adhere, (Tab. 42, fig. 13, *m n*.) The connexion of the pollen-tubes with the embryo-sac continues for some time after

* The fact of the general existence of a plurality of embryos in the impregnated ovule of Coniferæ and Cycadeæ was announced by Dr. Brown to the British Association at their meeting in Edinburgh in 1834, a few months previous to the date of this paper, which was read Sept. 1834. This announcement was, of course, unknown to M. Corda at that time.—*Trans.*

impregnation, even until the embryo has assumed an egg-shaped form, and has increased very considerably in size, becoming at the same time firmer and nearly opaque, (Tab. 44, fig. 22, a' and E.) At this period the embryostome contracts, (Tab. 44, fig. 22, f') the nucule becomes thinner, and being, as well as the secundine (d,) confined between the growing embryo within, and the primine (cc) without, both these membranes become very much compressed. The pollen-tubes (Tab. 44, fig. 22 a') are at this time very much attenuated and filiform, and so much shrivelled that neither cavity nor contents can be observed; they are, moveover, so much attenuated at the extremity next the embryo-sac that it becomes very difficult to trace them to that body, and demonstrate their connexion with its surface, which is now rough and nearly opaque.

About this time the pollen-tubes appear to fall away, and, on account of the solidifying of the albumen, it becomes impossible to perceive any vestige of its former presence.

After having considered the fecundation and the structure of the ovule, I undertook to examine the different integuments of the mature seed. The ripe seed of the *Rothtanue* (*Pinus Abies*) is furnished with a wing, (Tab. 44, fig. 30, x, and fig. 33,) the base of which (b) half surrounds the nut; the upper part, like a fine, thin, separated portion of integuments, forms the wing itself, (t.) This wing is nothing else than the inner skin of the lower part of the inner surface of the scale; and the line of separation is visible at an early period, (Tab. 44, fig. 21, t,) by which, when the seeds are ripe the cavity of the ovule opens and the formation of the wing is effected. By removing this wing, the nut is seen free from all connexion, (Tab. 44, fig. 30 w and 31.) The vestige of an opening is observable at its summit; (the endostome of the ovule (Tab. 44, fig. 31, 32 and 34 e' e',) called the micropyle by Turpin,) perforating the hard covering of the seed (*testa*) which represents the primine of the ovule, (Tab. 42, fig. 3; Tab. 44, fig. 21, 22, and 34, ccc.) Beneath the testa and partly coherent with it, is the inner covering of the seed, (Tab. 44, fig. 34, d,) a brownish skin which represents the secundine of the ovule, (Tab. 42, fig. 3, and Tab. 44, fig. 21, 22, and 34, d, d, d.) Its opening, the endostome (Tab. 44, fig. 34, $e^2 + f'$) is firmly connected with the embryostome, (Tab. 44, fig. 22 f') of the kernel-skin, (nucule,) (Tab. 44, fig. 21 f, 22 f, and 34 f.) In the fecundated ovule and ripe seed there is situated, in and near the orifice of these three integuments, a yellowish, firm and shrivelled body, of a loose texture, which was called by Gært-

ner Dotter (*vitellum,*) (Tab. 44, fig. 35—37, *vi.*) This vitellum I consider to be merely the remains of the pollen-grains which have fallen into the micropyle, (the exostome.)

The kernel-skin is filled with the albumen, in a cavity of which we find the embryo with its circularly-disposed cotyledons, (Tab. 44, fig. 38, 39, 40, 41, *co co*,) ordinarily nine in number, with their summits all turned inwards and thus enclosing the center of the embryo, which bears the name of the *embryo-bud,* (Tab. 44, fig. 41 and 42, *Eg Eg*.) I call the undeveloped summit (*Eg Eg*,) placed in the center of the whorl of the cotyledons, the embryo-bud, because it corresponds, not only in form and structure, but also in future office, with the terminal bud of Coniferous trees. In the one case the point of future growth is surrounded and enclosed by the cotyledons; in the other, leaves disposed in a similar manner enclose the so-named and similarly situated bud.

I endeavored in vain to detect in the soft embryo, the earliest formed bundle of fibres (which constitutes the skeleton of the plant,) but I could only bring to view a delicate homogeneous tissue, (Tab. 44, fig. 42, 43,) with a milky homogeneous fluid filled with white globular particles.

The following positions respecting the mode of impregnation in Coniferæ appear to be established by these observations.

1. The pollen-tube penetrates into the micropyle, (exostome;) and in Pinus the pollen-grains fall directly into it; whence the impregnation is immediate.

2. The pollen-tube passes through the exostome into the endostome, passes through the cavity of the secundine, and arrives at

3. The nucule; extends through the endostome into its cavity; and

4. By the ejection of the fluid contained in the pollen-grains into the bottom of the nucule gives the first *keim* (germ) to the formation of the embryo.

5. The formation and development of the embryo changes the contents of the cellular tissue of the nucule, which becomes fluid, and appears to furnish material for the growth of the embryo.

6. The pollen-tubes remain fixed (*to the embryo-sac*) sometime after impregnation and the commencement of the development of the embryo in the latter.

Note.—I am under great obligations to Lt. J. W. Bailey, Prof. of Chem., &c. in the West Point Mil. Acad., who has kindly undertaken to copy the greater part of the figures, illustrative of M. Corda's memoir. The figures occupy three plates in the original; but by omitting those of minor importance, we are enabled to present in two plates all which are essential to the elucidation of the memoir. The original numbering and lettering of the figures is of course retained.—A. G.

Art. XX.—*Additional Remarks on the Tails of Halley's Comet;* by Prof. B. F. Joslin.

Having just seen, for the first time, an article on Halley's Comet by the distinguished French philosopher, M. Arago, I am induced to make some quotations, and some additional remarks suggested by a comparison of observations.

The paper on the tails of Halley's Comet was read before the astronomical class in Union College, in February, 1836. I was afterwards gratified to find, in a number of the American Journal previously published,* a notice of the brush of light seen October 12th at Yale College. The observation here of the 12th of October was noticed in the Schenectady Reflector of the 14th. Whilst the paper on the tails of Halley's Comet was in the press, Mr. E. C. Herrick politely furnished me with some French extracts from a paper on this comet written by M. Arago, for the Annuaire for 1836, published by the Bureau des Longitudes. It appears that a similar brush, sector, or tail, (and sometimes more than one,) was seen in Europe and excited much interest:—length estimated at not less than two hundred thousand leagues, yet comprehended (like that seen here) within the fainter nebulosity. It appears to have been seen in the United States earlier than in any part of Europe, so far as the observations are given in the Annuaire. It was seen at Paris on the 15th, 16th, 17th and 18th of October; at Schenectady as a well defined tail with divergent sides, (or, as I have frequently called it, a sector, a term which M. Arago also employed,) on the 12th, 13th, 16th and 17th, as many evenings as at Paris. Whilst on the 14th, I have referred to the same thing seen more indistinctly, viz. such an increase in the density or luminousness in the interior of the envelope on one side of the nucleus as to render it visible in a state of the atmosphere when the envelope could not be seen with the telescope at the same distance in other directions. But in both cases I have with others regarded it as comprehended within the envelope, and as being a tail only to the nucleus. It appears from the Annuaire, that M. Schwabe, a German astronomer, in a memoir presented to the Academy of Sciences, has used a similar term, calling the luminous sectors, opposite to the tail properly so called, "secondary

* Vol. XXIX, No. 1, p. 156, October, 1835.

tails." I believe the one seen here and in England* was also called a tail by an English astronomer. Six rays were seen in Germany on the 13th, when the state of the sky was here unfavorable. The sector of the 16th was here divisible into three. Three sectors were seen at Paris on the 21st, when the comet itself was to us invisible. But in all the published observations made at Paris, there is a close correspondence with those made simultaneously here, and with some not simultaneous. This is more than was to be expected, considering the difference of instruments. This correspondence will be seen from the following extracts from the Annuaire. "15th October, 1835, at 7 o'clock in the evening, the great telescope of the observatory of Paris, furnished with a great magnifying power, enabled one to perceive in the circular nebulosity which is called the chevelure, a little to the south of the point diametrically opposite the tail, a sector, comprehended between two lines sensibly straight directed toward the center of the nucleus. The light of this sector exceeded remarkably that of all the rest of the nebulosity. Its two limiting rays were distinctly defined." Their angle is not stated. The above description as to form and brightness is applicable to the appearance here on the 12th. The position, however, was different; and this circumstance, if its identity could be established, would afford evidence of a rotation in the comet. But the published data are not sufficient. It may have been a different sector. "On the next day, the 16th, after sunset, it was perceived that the sector of the 15th had disappeared; but in another part of the head, to the north, this time, of the point diametrically opposite to the axis of the tail, there was formed a new sector." It was considered a new one, "on account of its situation, its truly extraordinary brilliancy, the perfect distinctness of the rays by which it was bounded, and its great angular opening, which exceeded 90°." A similar view was afforded by our telescope, except that with it the sector of "about 90°" (which was the angular opening that I had assigned to it,) was divisible into three others, viz. two equal lateral ones and a more brilliant central one embraced by the two former, as though a brilliant cone was surrounded by a conical brush of less brilliancy but still greatly exceeding in brightness the rest of the nebulosity. Is it not probable that with a telescope having a far greater aperture than ours, the brilliancy of the whole might appear so intense as to render the difference in brilliancy between the lateral and middle parts less apparent?

* I do not know on what day.

There is also a great resemblance between the results here and those at Paris on the 17th. There, " on the 17th, the sector of the preceding evening still existed. Its form and its direction appeared not remarkably changed, but its light was much less vivid." Here, as quoted above from the journal, " the sky is much less clear than on last night, and the envelope, condensed on one side to form the short tail, is indistinct; yet its direction and form seem not to have been sensibly changed since last evening."

At Paris on the 18th, " l'affaiblissement avait fait de nouveaux progrès." Schenectady, 18th, the proper tail " seen directly is longer and indirectly shorter than it was on the 16th. The atmosphere appears to be less clear. In consequence of this and of the wind, the nucleus is not discernible." When the sky is free from clouds, may there not be frequently a precipitation or crystallization of vapor to a great horizontal extent, in the elevated regions of the atmosphere, which, whilst it has less effect on bright stars and the more brilliant part of a comet's tail, entirely cuts off that fainter portion which is seen by oblique vision? It would be interesting to know in what degree the fading of other parts, which on some days made similar progress as seen at Schenectady and Paris, was owing to the above cause, or whether, as M. Arago assumes, it was solely a change in the comet. That it did undergo real changes can scarcely be doubted. But can any exact estimate be made of these till we can determine those in our atmosphere? But whatever may be the real changes in the head and tail, the difference in the length of the latter as seen simultaneously at Paris and Schenectady must depend chiefly upon the meteorological or physiological circumstances enumerated in the preliminary remarks. I include physiological, as it is not stated by M. Arago what was the position of the optic axis at the time of the observations from which the length of the tail was deduced, or whether it was ever inclined to the visual ray. On the 4th of October it could be seen here in no other way. I have seen no account of its appearance elsewhere previous to the 10th. On the 16th, it appeared at Paris to be from 10° to 12°. At Schenectady on the same day, it was 7° or 8° by direct, and 45° by oblique vision; next evening 35°. *At none of the former returns of this comet has the tail ever been represented as having such lengths anterior to the perihelion passage.* Nor since 1456, has it, after the perihelion passage, been seen of such lengths as those given above, which were a month before, if we except a single

observation of M. de la Nux in 1759, when its maximum lengths were 19°, 25°, and 47°. Whenever it presented such lengths, it was very narrow, ("elle s'amincissait beaucoup:"—and "l'amincissement était devenu extrême.")* It is an interesting coincidence, that an unusual narrowness through the greater part of its extent, characterized it at its recent appearance when at its greatest lengths, i. e. 25°, 35°, and 45°. From this circumstance we may, in the absence of any positive information, presume that M. de la Nux saw it indirectly. Before the perihelion passage a tail was scarcely if at all detected.† The mean of the above *lengths* observed on the 16th, 17th, and 11th of October, 1835, appears to be *greater than that given by any three observations since* 1456, *either before or after the perihelion passage.* This is not to affirm, that, including all its dimensions, its magnitude is greater; for, except in 1759, the narrow portion may have been wanting. It is, moreover, not improbable, that most observers have given the length as seen with a moderate obliquity of the optic axis, a length intermediate between the real minimum and maximum for any one instant, or in other words, intermediate between the length of the whole and that of the part possessing nearly a maximum intensity.

The greatest length alluded to in the Annuaire as seen at Paris at the late return, is 20°. It was with the naked eye, but whether with the axis directed toward the object, is not stated. The sky here was cloudy and foggy; length less than 2°. At the observatory of Paris on that evening, it appeared but half as long with the finder as to the naked eye. This M. Arago pronounces "a result truly singular." I frequently observed the same thing with the five feet telescope and attributed it to the moderate aperture of the instrument. Could not this have been the cause in both cases? This effect was not produced by our 2¼ ft. telescope having a larger aperture compared with its magnifying power, and was more remarkable with the higher than with the lower magnifying powers of the larger telescope.

Although the Annuaire contains numerous observations of the length of the tail at the former returns of the comet, it gives but three for 1835. The last was by M. Schwabe at Dessau, who found it to be 7° on October 26th, when clouds here obstructed the view. The new moon and the opacity of "Indian summer" were for a while

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* Annuaire, p. 227. † p. 229.

afterwards unfavorable. On the 9th November the length was about $2\frac{1}{2}°$ as seen with the portable telescope by my friend C. H. Stillman, who had often assisted me in the observations. On the 16th the tail of 45° was shown to many of the senior class who had been for a time studying optics and had been instructed in regard to the difference between the results afforded by different modes of observing.

M. Arago with great candor combats the opinion which he lately supported in regard to the perishable character of this comet. The observations of the tail and other parts of this comet at its last return, have convinced him and most astronomers that there is no evidence of any recent diminution. So far as my observations have a bearing they will tend to confirm this last opinion. As to the changes which have been generally believed to have taken place between former returns, but which begin to be regarded as only apparent; they may probably be explained on other principles stated in the preliminary remarks to the other article.* Some of these principles are applicable also to some of the daily and instantaneous variations.

Schenectady, Oct. 1st, 1836.

The foregoing remarks were communicated for the October No. of this Journal, but too late for insertion. I have more recently seen extracts from an article in the Bibliothèque Universelle of Geneva, relating to a memoir on the physical constitution of the comet of Halley, by M. Bessel, the illustrious astronomer of Königsberg.† His views on this subject appear to differ in some respects from those of the equally distinguished French savant above quoted. What M. Arago "did not hesitate to name" a *new* sector, appears to be regarded by M. Bessel as *the* sector in different positions. It appears that he never saw but one. Reference is made to it also under the names of luminous emanation, emission, effluvia and eruption; terms expressive of its nature or mode of development. M. Bessel speaks of it as the cone and the sector, terms which were employed in the first article.‡ By the former we intend to express its actual form, by the latter that of its projection. These terms are sufficiently exact, though M. Bessel sometimes de-

* Vid. also the Annuaire, and the last No. of this Journal.

† I am indebted for these to the same correspondent who furnished the former extracts.

‡ Last No. of the American Journal.

tected a curvature on one side. They will, however, scarcely distinguish this emanation from some of those to which the name tail has been generally appropriated.

If we call this cone a tail, it would be desirable to classify these appendages. Were there others, like the cone of Halley, traceable directly to the nucleus by observation alone, we might denominate them caudæ nuclei, in contradistinction to the ordinary appendages of the envelope. But let us see whether there are not physical considerations which should induce us to make this class more extensive. As some luminous emanations are nearly opposite to the sun, and retain a position nearly constant in relation to the radius vector, and as others, which are usually much shorter, have different and variable positions in relation to the radius vector of the comet, but in all probability positions nearly or exactly constant in relation to the radius of its nucleus at the point of emanation, we might still distinguish the latter as the tails of the nucleus, (although in some instances, as in the comet of 1825, they are not *directly* traceable to it by observation,) and the former as the caudæ solares of comets, on account of their characteristic position and peculiar mode of development. In the former article, I hazarded a conjecture as to the fact of a rotation of the nucleus of Halley, suggested by observed differences in the position of the cone on different days. This interesting fact, (or what for our present purpose is equivalent to it,) may now be regarded as established by the observations of M. Bessel, not only on different days from the 2d to the 25th of October, but during 8 or 9 successive hours on the 12th, during which there was a rapid progressive motion from right to left. It is an interesting circumstance, that the angular opening of the cone, ("about 90°"*) observed at Königsberg on the 2d of October, was the same as that observed at Schenectady on the 16th. This tends strongly to confirm the identity of the cone at distant epochs, and affords some data for determining the period of rotation, as there are reasons for believing that most of the angular changes of the intermediate periods were not real, but resulted from variations in the obliquity of the axis of the cone in relation to the visual ray. If we assume three complete rotations with an equable motion between the 2d and 16th of October, the period of each must have been $4\frac{2}{3}$ days. Now M. Bessel (from data which have not yet

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* Bib. Univ. Avril, 1836, p. 357.

been received here) fixes the period of rotation or (as he is disposed to regard it) of oscillation, at $4\frac{6}{10}$ days, which is nearly the same. Not knowing the hour of M. Bessel's observation, (mine was 7, P. M.) nor the *exact* angle of the cone as estimated by him on the 2d, I make no correction for difference of hour or of longitude. My estimate of the angle on the 16th, may not have been so exact as to render this important.* Indeed, M. Bessel found that from the 2d to the 25th, the discrepancy between his observations and his oscillatory hypothesis was considerable, "but scarcely exceeded, except for a single day, the limits of uncertainty of which observations of this kind are susceptible."† He found the discrepancy still greater with the hypothesis "of an uniform motion of revolution of the axis of the sector around the straight line drawn from the comet to the sun."‡ I regret that his important memoir is not at present accessible, as it might afford a reason which does not occur to me, for the assumption of this particular position of the axis of rotation. Perhaps a different position might satisfy the conditions imposed by the observations. If we assume the fact of a rotation, then there are originally three unknown elements, viz. its period, the direction of its axis, and the *actual* angle between it and the axis of the cone. The first element may be determined by the position and angular opening of the cone at different epochs; either of the latter two may be variously assumed, and their possible combinations are infinitely numerous. The actual and complete revolutions observed by Mr. Dunlop in the short tails of the comet of 1825,§ seem to favor the hypothesis of rotation in the nucleus of Halley. But either this or the oscillatory hypothesis of M. Bessel, will if established, (and it is scarcely possible to reject both,) justify the foregoing distinction in regard to the two classes of cometary tails. Those of one class assume different and variable positions with respect to the radius vector of the comet, and are projected from certain invariable parts of the nucleus, either in consequence of the volatilization of matter from an unequally volatile surface, or of its expulsion through orifices by the agency of an interior explosive force, or they are formed by some auroral action in

* This however being an angle of 90°, could be much more exactly estimated by the eye than the other angles.

† Bib. Univ. p. 359. ‡ Id.

§ See plates and description in Edinburgh Journal, Vol. VI, p. 84.

its atmosphere, and have a relation to certain magnetic poles of the nucleus.

It may perhaps be worthy of consideration, that if the earth had an atmosphere as extensive as that of Halley, and only one north magnetic pole, a terrestrial aurora borealis completely circumpolar and sufficiently brilliant to be seen at the distance of the comet, would have appeared from that position as a conical tail, and its axis, being in the magnetic axis of the earth, would have appeared like that of the cone of Halley to revolve around the earth's astronomical axis. A greater number of poles might render the tails more numerous or irregular, as in the comet of 1825. In either case they might occupy fixed situations on the surface, their axes making constant angles with the axis of rotation. This hypothesis would allow real and simultaneous variations in length and brilliancy, and such a diminution of the latter at the edges as was observed here on the 16th of October. At Königsberg on the 13th and 14th, the sector was still more luminous than on the 12th, the day of the comet's perigee, and could be distinguished even to the distance of 45″ from the comet's center. On the 12th the distance was 30″. On the 13th it was stated here, in the journal published in the last number,* that it appeared to extend three or four times as far from the nucleus as it did the preceding evening. These observations tend to establish the fact of a real augmentation of angular length, though the amount differed from difference of atmosphere, &c. What was meant by nucleus was immediately explained. No real nucleus was at any time seen ; and this accords with M. Bessel's observations.†

In regard to the class of ordinary tails, they remain, notwithstanding the rotation of the nucleus, nearly opposite to the sun ; perhaps by the agency of some repulsive force of an electrical or magnetic nature emanating from it. Is there any evidence that the material of these ever assumes its determinate direction until it has risen to some distance from the surface of the nucleus ? May not this be in part referable to the diminution of gravitation or the coercive force of the nucleus, as the vapor in consequence of its elasticity and buoyancy departs in all directions from the nucleus, till at length its gravitation toward the nucleus is overcome by the repulsive force emanating from the sun ? And may it not be also in part referrable to the development of electrical and perhaps magnetic properties by a

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* Vol. XXXI. p. 149. † Bib. Univ. p. 360.

crystallization of vapor which takes place when the mass has risen a sufficient distance from the heated nucleus, the vapor itself, like that of our atmosphere being less susceptible of being directly heated by solar radiation?

Is there any other explanation than the latter, of the transparent invisible stratum, which often to a sensible extent surrounds the envelope and is itself embraced by curved prolongations of the lateral portions of the train?

Union College, Schenectady, Nov. 25th, 1836.

Art. XXI.—*Proceedings of the British Association at Bristol in August* 1836.*

From the Edinburgh New Philosophical Journal, Oct. 1836.

GENERAL OFFICERS.

President.—The Marquis of Lansdown; but owing to his unavoidable absence, his place was taken by the Marquis of Northampton.

Vice Presidents.—Rev. W. D. Conybeare, F.R.S., James C. Prichard, M.D. F.R.S.

General Secretaries.—Rev. William V. Harcourt, F.R.S., Francis Bailly, F.R.S.

Assistant General Secretary.—Prof. Phillips of King's College.

Treasurer.—John Taylor, Esq. F.R.S., F.G.S.

LOCAL OFFICERS.

Treasurer.—George Bengough, Esq.

Secretaries.—Prof. Daubeny, V. F. Hovenden, Esq.

Section A.—Mathematical and Physical Science.

President.—Rev. W. Whewell, F.R.S.

Vice Presidents.—Sir D. Brewster, Sir W. R. Hamilton.

Secretaries.—Prof. Forbes, W. S. Harris, Esq. F.R.S., F. W. Jerrard, Esq.

The following Memoirs were read, and statements made, and more or less extensively discussed:—1. Notice regarding the progress made in the construction of a lens of Rock-salt, by Sir D. Brewster. 2. Account of the recent tide observations made at the

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* Report prepared from accounts in Athenæum, Felix Farley's Bristol Journal and private communications.

ports of London and Liverpool, by Mr. Lubbock. Mr. Lubbock stated, that through the indefatigable exertions of Mr. Dessiou, considerable progress had been made in the reduction of the observations made at Liverpool by Mr. Hutchinson. The diurnal inequality or difference between the superior and inferior tide of the same day, which in the Thames was very inconsiderable, if not insensible, was found at Liverpool to amount to more than a foot; a matter upon which the learned gentleman laid considerable stress, as calculated to lead to important practical results. The object of these reductions was to compare the results of theory with these observations, and with those of Mr. Jones and Mr. Russell made at the port of London. The principal objects of comparison were the heights of the several tides, and the intervals between tide and tide; and these were examined in their relations to the parallax and declination of the moon and of the sun, and in reference to local, and what may in one sense be called accidental causes, as storms, &c. Of this latter, one of the most curious, as well as important, is the effect of the pressure of the atmospheric column. The author stated, that M. Daussy had ascertained, that at the harbor of Brest a variation of the height of high-water was found to take place, which was inversely as the rise or fall of the barometer, and that a fall of the barometer of 0.622 parts of an inch, was found to cause an increase of the height of the tide, equal to 8.78 inches in that port. To confirm this interesting and hitherto unsuspected cause of variation, had been one principal object of the researches of the learned gentleman; and, at his request, Mr. Dessiou had calculated the heights and times of high-water at Liverpool for the year 1784, and compared them with the heights of the barometer, as recorded by Mr. Hutchinson for the same year: and by a most careful induction, it had turned out that the height of the tide had been on an average increased by one inch for each tenth of an inch that the barometer fell, *cæteris paribus;* but the time was found not to be much, if at all affected. Mr. Lubbock then proceeded to examine the semi-menstrual declination and parallax correction, and stated that the result was a remarkable conformity between the results of Bernouilli's theory and the results of observations continued for nineteen years at the London docks. But to render the accordance as exact as it was found to be capable of being, it was necessary to compare the time of the tide, not with that transit of the moon which immediately preceded it, but with that which took place about five lunar half days previously. To

explain this popularly, Mr. Lubbock stated, that, however paradoxical it might appear to persons not acquainted with the subject, yet true it was, that, although the tide depended essentially upon the moon, yet, any particular tide, as it reaches London, would not be in any way sensibly affected, were the moon at that instant, or even at its last transit, to have been annihilated; for it was the moon as it existed fifty or sixty hours before which caused the disturbance of the ocean, which ultimately resulted in that tide reaching the port of London. The author then exhibited several diagrams, in which the variations of the heights of the tide, as resulting from calculations founded upon the theory, were compared with the results of observations. The general forms of the two curves which represented these two results, corresponded very remarkably; but the curve corresponding to the actual observations, appeared the more angular or broken in its form, for which Mr. Lubbock satisfactorily accounted, by stating, that the observations were neither sufficiently numerous, nor sufficiently precise, from the very manner in which they were taken and recorded, to warrant an expectation of a closer conformity, or a more regular curvature. When it is recollected that the observations are at first written on a slate, and then transferred to the written register, by men otherwise much employed, and whose rank in life was not such as would lead us to expect scrupulous care, it was not to be wondered at, if occasionally an error of transcript should occur, or even if the observation of one transit was set down as belonging to the next. When to these circumstances it was added, that the tide at London was in all probability, if not certainly, made up of two tides, one having already come round the British Islands, meeting the other as it came up the British Channel, it was altogether surprising that the coincidence should be so exact; and it was one among many other valuable results of these investigations, that it was now pretty certain, that tide tables constructed for the port of London by the theory of Bernouilli, would give the height and interval with a precision quite sufficient for all practical purposes, and which might be relied on as sufficiently exact, when due caution was used in their construction, and the necessary and known corrections applied. In conclusion, Mr. Lubbock stated that the observations for the port of London had now been continued from the commencement of this century, and those for Liverpool, as we understood, about twenty-five years.

3. Mr. Whewell gave an account of the proceedings of the committee appointed to fix lines of the relative level of sea and land. He commenced by saying, that as in the discussion of the relative level of land and sea, the tides of the ocean were an important element, he should preface the remarks upon that subject, which he intended to submit, by making a few observations upon the very valuable communication of his friend Mr. Lubbock. This communication he highly eulogized, and pointed out to the Section the importance of many of the conclusions, should they prove hereafter to be generally applicable; but he expressed strongly his fears that this would not be the case. Observation had, in the instance of the tides, far outstript theory, for many reasons, which it would be impossible to detail; but among the most prominent were the complexity of the problem itself involving the astronomical theories both of the sun and moon; the masses of these bodies; the motions of disturbed fluids, and local causes tending to alter or modify the general geographical effect of the great tide-wave at any particular place. It was upon a careful review of these considerations, that he was led to fear that it would be still many years before theory would become so guarded and supported by local observations, as to afford a sufficiently correct guide to be implicitly relied on in these speculations. He instanced the tides of the Bristol Channel, which in consequence of their excessive magnitude, afforded magnified representations of the phenomena by which the deviations become more remarkable. At the port of Bristol, the tide rose to a height of fifty feet, while towards the lower part of the channel it only rose twenty, and along other parts of the coast not quite so high. The most striking of Mr. Lubbock's conclusions was that by which it appeared that the ocean assumed the form of the spheroid of equilibrium, according to the theory of Bernouilli but at five transits of the moon preceding the tide itself. By the calculations of Mr. Bent, however, it would appear, that although the observed laws of the tides at Bristol might be made to agree with Bernouilli's theory of equilibrium tides, by referring them to a certain anterior transit,—so far as the changes due to parallax were concerned, as also as far as those due to declination were concerned,—yet it turned out that this anterior period itself was not the same for parallax as for declination. The two series of changes have not therefore a common origin or a common epoch; so that in fact there is no anterior period which would give theoretical tides agreeing with observed tides; and, therefore, at

least the Bristol tides do not at present appear to confirm the result obtained by Mr. Lubbock from the London tides. Mr. Whewell then illustrated these views by diagrams, by the aid of which he explained to the section the luni-tidal intervals, and the curve of semimenstrual inequality—(this latter term, and the doctrine connected with it, was introduced into the subject of the tides by the professor himself.) Prof. Whewell then proceeded to the question more immediately before him—the proceedings of the committee appointed to fix the relative level of the land and sea, with a view to ascertain its permanence, or the contrary. He observed, that the committee had not taken any active practical steps for the important purposes for which they were appointed, because they had met with many unexpected difficulties requiring much consideration. It was, however intended to appoint a committee for the same purposes, who should be furnished with instructions founded upon the views at which the former committee had by their labors and experience arrived. One method proposed was, that marks should be made along various parts of the coast, which marks should be referred to the level of the sea; but here the inquiry met us in the very outset —what is the proper and precise notion to be attached to the phrase the *level of the sea?* Was it high water mark or low water mark? Was it at the level of the mean tide, which recent researches seemed to establish? In hydrographical subjects the level of the sea was taken from low water, and this, although in many respects inconvenient, could not yet be dispensed with, for many reasons, one of which he might glance at—that by its adoption, shoals, which were dry at low water, were capable of being represented upon the maps as well as the land. The second method proposed appeared to be one from which the most important and conclusive results were to be expected. It consisted in accurately leveling, by land survey, lines in various directions, and by permanently fixing, in various places, numerous marks of similar levels at the time; by the aid of these marks at future periods, it could be ascertained whether or not the levels, in particular places, had or had not changed, and thus the question would be settled whether or not the land in particular localities was rising or falling. Still further, by running on those lines, which would have some resemblance to the isothermal lines of Humboldt, as far as the sea coast, and marking their extremities along the coast, a solution would at length be obtained to that most important practical question,—what is the proper or permanent level

of the sea at a given place? Until something like this were accomplished, Mr. Whewell expressed his strong conviction of the hopelessness of expecting any thing like accuracy in many important and even practical cases. As an example, he supposed the question to be the altitude of Dunbury Hill referred to the level of the sea: if that level of the sea were taken at Bristol, where the tide rises, as before stated, fifty feet, the level of low water would differ from the same level on the sea coast at Devonshire, where the sea rises, say eighteen feet; and supposing, as is most probable, the place of mean tide to be the true permanent level by no less a quantity than sixteen feet, which would therefore make that hill to appear sixteen feet higher, upon a hydrographical map constructed by a person taking his level from the coast of Devonshire, than it would appear upon the map of an engineer taking his level at Bristol. In the method proposed, the lines of equal level would run, suppose from Bristol to Ilfracombe in one direction, and from Bristol to Lyme Regis in the other, and by these a common standard of level would soon be obtained for the entire coast.—Prof. Sir William Hamilton rose to express the sincere pleasure he felt at the masterly expositions of Mr. Lubbock and Prof. Whewell. One conclusion to which Mr. Lubbock had arrived was to him peculiarly interesting, viz. that by which it appeared that the influence of the moon upon the tides was not manifest in its effects until some time after it had been exerted, for a similar observation had recently been made by Prof. Hansteen respecting the mutual disturbances of the planets.—Mr. Lubbock rose to say, that the agreement between the results calculated from the theory of Bernouilli and those obtained from actual observation, was much more exact than Prof. Whewell seemed to imagine; in truth, so close was the agreement, that they might be said absolutely to agree, since the difference was less than the errors that might be expected to occur in making and recording the observations themselves.—Mr. Whewell explained that he wished to confine his observations to the Bristol tides, as these were the observations to which he had particularly turned his attention; and, with respect to which, he should be able, at the present meeting, to exhibit diagrams to the section, which he felt confident would amply bear out his assertions respecting these tides.—Mr. Lubbock stated, that so near, indeed so exact, had been the coincidence between the observations made at London and Liverpool, and the theory, that he was strongly inclined to believe that that coincidence would be

found at length to be universal.—Prof. Stevelly inquired, from Mr. Lubbock, whether he did not think it quite possible that local causes might exist, which would be fully capable of producing the deviations from the theory of Bernouilli; as, for instance, in the case of Bristol, so ably insisted upon by Prof. Whewell, where the causes of the extraordinary elevation are the land-locking of the tide-wave as it ascends the narrowing channel, and the reflexions of other tide-waves from several places. Now, particularly in the case of reflex tides, may it not so happen, and does it not, in fact, happen in several places, that they bring the actual tide to a given port at a time very different from that at which the influence of the moon and sun, if unimpeded, would cause it to arrive, and thus separate, as Prof. Whewell had stated, the origin or epoch of the variations due, suppose to parallax and declension, and even cause other deviations from Bernouilli's theory?—Mr. Lubbock replied, that unquestionably it might so happen; but in his opinion, the discussion of a few observations, like those made at Bristol, could not be expected to point out very exactly the origin or epoch of either of the variations of parallax or declination, with sufficient exactness, to furnish secure data for determining that they did not correspond to any one common previous transit of the moon.—Prof. Whewell exhibited some diagrams, which tended to illustrate his view of the question; and, in particular, he drew the attention of the section to the circumstance, that the diurnal inequality, which was now beginning to be observed, decided the question, inasmuch as its epoch could not by any means be attributed to the same previous transit of the moon to which the others were referred.—Mr. Frend congratulated the meeting upon the prospect now held out of determining precisely that most important practical question, the true level of the sea.

Mr. Lubbock next made a communication respecting the formation of an empirical lunar theory.

Prof. Sir William Hamilton read his report on Mr. George B. Jerrard's mathematical researches, connected with the general solution of algebraic equations.

Prof. Phillips read his report of the experiments instituted with a view to determine the temperature of the interior of the earth.

Prof. Forbes gave an account of the experiments he had directed to be made on subterranean temperature at the Lead Hills in Scotland.

The Rev. Mr. Craig read a paper on polarized light.

Section B.—Chemistry and Mineralogy.

President.—Rev. Prof. Cumming.

Vice Presidents.—Dr. Dalton, Dr. Henry.

Secretaries.—Dr. Apjohn, Dr. C. Henry, W. Herapath, Esq.

Mr. Watson read a paper on the phosphate and pyrophosphate of soda.

Mr. Ettrick noticed a new form of blowpipe, by which the blast of the common blowpipe was made as equable as that produced by water pressure.

Mr. Herapath then drew the attention of the section to the composition of Bath water, as recently determined by him, and detailed the methods of analysis which he adopted, and the results at which he arrived.

Dr. Hare next described his apparatus for the analysis, on the plan of Volta, of gaseous mixtures.

Mr. Herapath read a paper on the theory of the aurora borealis. He stated that he always found this phenomenon to be low in the atmosphere, and in connection with clouds. Hence he inferred that it is occasioned by electricity passing from the clouds.

Section C.—Geology and Geography.

President.—Rev. Dr. Buckland.

Vice Presidents.—R. Griffith, Esq., G. B. Greenough, Esq.

(*For Geography*) R. I. Murchison, Esq.

Secretaries.—W. Sanders, Esq., S. Stutchbury, Esq., T. J. Torrie, Esq.

(*For Geography*) F. Harrison Rankin, Esq.

A memoir was read by Mr. E. Charlesworth, being a notice of vertebrated animals found in the crag of Norfolk and Suffolk. The principal object in bringing forward this subject, was to establish the fact of the remains of mammiferous animals being associated with the mollusca of the tertiary beds above the London clay, in the eastern counties of England. These remains are confined to a part of the crag formation, which appears to extend from Cromer in Norfolk, to within a few miles of Aldborough in Suffolk, and the depth of which was very great, wells having been sunk in it without reaching its bottom. The bones of fish, and a large portion of the testacea met with in the stratum, differ widely from those of the coralline beds, and from that part of the crag deposit which skirts the southern

coast of Essex and Suffolk. Among the mammalia, which the author states really belong to the crag, is the *Mastodon angustidens*, of which several teeth have recently been obtained in Norfolk from localities adjoining the parish of Withingham, the spot from which Dr. W. Smith states the specimen to have been procured which is figured in his "Strata Identified." Mr. Charlesworth conceived the discovery of the remains of the mastodon in this formation, as affording an argument to prove the relative ages of these rocks, as no remains of this animal have been found in America in beds more ancient than the diluvial. The remaining genera of mammiferous animals can be identified with those now existing, or with such as are found in diluvial and lacustrine deposits. The author next notices the discovery of the mineralized remains of birds, chiefly bones of the extremities of natatorial tribes, a solitary instance of a similar discovery in America being the only one recorded. He was not prepared to speak concerning the different kinds of fish, but he stated their distribution—species of Squalus being found near Orford, and what Agassiz conceives to be Platex, at Cromer. Among the most remarkable is the Carcharias megalodon, the teeth of which are found in Suffolk, equal in size to specimens from the tertiary formations of Malta. He also alluded to the difference of the testacea in different parts of the crag, from which he was inclined to infer there were several eras in its formation. No traces of the existence of reptilia have yet been detected, which would rather support the opinion of Dr. Beck and Deshayes, that the climate during the crag epoch was analogous to that of the polar regions.—Prof. Sedgwick stated, that he had been long aware of the existence of remains of mammalia in the Norfolk crag, although this had been disputed by Mr. Conybeare, in his work on the Geology of England and Wales. He was rather inclined to consider the crag as all of one epoch; and Mr. Lyell had found existing species as numerous in the lower as in the upper crag. With regard to Mr. Charlesworth's idea of the extinction of the mastodon in England before the formation of the diluvial beds, Prof. Sedgwick conceived that it was reasoning from a negative fact, and that until more extensive search had been made, no such inference could be fairly drawn. He also mentioned that remains of the beaver were found in the alluvions of Cambridgeshire, and that it might have existed in England a thousand years ago. He was confident that no cause still in existence could have produced the diluvium on the crag; its whole appear-

ance suggested the idea of a great rush of waters.—Mr. Conybeare was perfectly willing to correct his opinion respecting the existence of the remains of mammalia in the crag. He was of opinion that the tertiary strata of America had not been sufficiently examined to justify the conclusion that it did not contain remains of the mastodon. He started a question—which of the species of mastodon found in other countries did the British one resemble?—Mr. Greenough mentioned, as a singular peculiarity of the diluvium of Norfolk, its containing large masses of chalk, which contain organic remains differing in some respects from those of the chalk *in situ.* The town of Cromer seemed to be built on an immense block of chalk, contained in the diluvial formation.—Mr. Murchison dissented from Mr. Greenough's opinion. He conceived the formation of chalk was under the diluvium, and had been elevated and disrupted. He had seen at Hazeborough large platforms of chalk laid bare after a storm; near that place were needle-shaped rocks of chalk, and at Cromer the foundation of the town must rest on part of the same mass. There were strong reasons for believing that the Norfolk diluvium contained recent shells only. Mr. Lonsdale, on examination, could discover no others.—Mr. Charlesworth mentioned, that Dr. Beck considered the shells of the tertiary period to be extinct species, and that at the formation of the Norfolk crag the climate must have been very cold, like the Arctic regions. He considered the diluvial formation to have been sufficiently searched to warrant an opinion that it does not contain the remains of the mastodon. Many singular organic remains have been found there, which have been transported, as of saurians, which must have come from Yorkshire. In alluding to the fact of shells similar to those of the crag being found at Bridlington, he was informed by Mr. Sedgwick that the formation at that place was probably part of the crag.

A paper, by Mr. J. B. Bowman, was now read, on the Bone Caves at Cefn, in Denbighshire. A description of these has been already published in the *Edinburgh New Philosophical Journal.* The caves are in the carboniferous limestone. The roof of the lower cave is covered with stalactites, which are often broken off or blunted. The diluvium on the floor contains fragments of slate, and the upper portion animal remains in great abundance. Among these are some of a very minute size, and also elytra of beetles. A black matter is also found, with veins of reddish clay. The bones are often in fragments; the teeth are somewhat worn; sometimes

the teeth are of young animals, but no indentations have been found upon them. No skulls have been discovered, nor any coprolites. The bones frequently contain gelatine, and have often manganese upon them; hair was also discovered. The stalactites seem confined to the anterior part of the cave; in the posterior part a fine sand is found.

After this, a desultory conversation took place on the exhibition of two models by Mr. Ibbotson, one of the country round Neufchatel, in Switzerland, on the scale of half an inch to the mile; and the other of a part of the Under Cliff in the Isle of Wight, on the scale of three feet to the mile.

Mr. Greenough mentioned a new mode of engraving medals lately adopted in France, and which he conceived could be advantageously employed in laying down the varieties of surface on maps. —Mr. Griffiths spoke of the great importance of models like Mr. Ibbotson's, as being so well calculated to display the geological structure of a country. He suggested the importance of possessing maps, both of outline and of features, and he alluded to the magnificent map of Ireland, under the Ordnance Survey, the scale of which, being six inches to a mile, enabled the geological observer to trace the geological features with a facility before unknown.—It was mentioned, that the new map of Austria was on a scale of twenty-two inches to the mile, but this Mr. Greenough considered inconveniently large.—Mr. Ibbotson stated, that models could be easily multiplied by employing a metal mould, and using *papier maché*, or some preparation of caoutchouc; and that they might be dissected to exhibit the internal structure, and that the materials of the strata themselves could be used as coloring matter.—Lord Northampton and M. de la Beche gave their testimony of approval.—Several gentlemen then spoke of the application of combinations of letters to geological maps, to express the more minute geological phenomena; but the general opinion was, that in geological maps simplicity should, as much as possible, be preserved, and that the best mode would be to have two maps of the same district, one without names, for the geological map, and the other with the necessary writing. Maps of this kind had been given to the Geological Society by the Archduke John of Austria.

Section D.—Zoology and Botany.

President.—Prof. Henslow.

Vice Presidents.—Rev. F. W. Hope, Dr. J. Richardson, Prof. Royle.

Secretaries.—John Curtis, Esq., Prof. Don, Dr. Riley, S. Rootsey, Esq.

Dr. Richardson commenced the proceedings of the Section, by reading the introductory portion of his report "On the Zoology of North America." It did not appear probable that the progress of colonization had, as yet, extinguished any one species of animal from the country. The great similarity which existed between the animals of North America and those of Europe, as regarded their generic distinctions, connected with the dissimilarity of their species, rendered them well adapted to inquiries connected with their respective geographic distribution. Hitherto the trivial names bestowed by the colonists upon many of those of North America, had tended to mislead naturalists. The observations in the present report would principally refer to the western parts of North America, including New Mexico, the Peninsula of Florida and California, down to the well defined limits of the South American zoological province. Dr. Richardson then proceeded to describe the physical structure of this country, of which the Rocky Mountains formed a most remarkable feature. The altitude of many of their peaks rose above the limits of perpetual snow, and their sides were flanked by zones of different temperature, affording passages for animals from the Arctic circle to the table lands of Mexico, without any great alteration of climate throughout the whole extent. The temperate zones of both hemispheres might, in this way, be connected, were it not that the Cordilleras were greatly depressed at the Isthmus of Panama, and that a plain extended from sea to sea a little further to the south. As yet we possess no information of the elevation of the backs of these mountains, independent of the heights of some of the peaks, and the elevation of the base of the range is equally unknown. The depths of some of the transverse valleys are considerable, and these afford passages for the migration of animals. Most of the principal rivers flowing to the east cut across the chain, and one actually rises to the west of the crests of the range. On the Atlantic side are prairies, composing plains gently inclining to the east, and there is an extent of land which may be likened to a long valley, which stretches from the Arctic Sea to Mexico, without any transverse ridges dividing it, but merely affording three distinct water-sheds. The greatest width of the plain is about 15° of lon-

gitude, in the 40° to 50° of north latitude. This configuration gives great facility for the range of herbivorous quadrupeds from north to south, and for the migration of low-flying birds; whilst the Mackenzie furnishes a channel by which the anadromous fish of the Arctic Sea can penetrate 10° or 11° of latitude to the southward, and the Mississippi enables those of the Gulf of Mexico to ascend far to the north. The most remarkable chain east of the Mississippi, is that of the Alleghanies, which is about one hundred miles broad, rises from a base between one thousand and one thousand two hundred feet, and attains an elevation from two thousand to three thousand feet above the sea. The strip of land between them and the coast is two hundred miles broad in the Carolinas; becomes still broader in Georgia, and, sweeping round the northern extremity of the chain, joins the valley of the Mississippi. This strip influences the distribution of animal life, by extending southerly to the 5° of latitude, thus forming also a barrier to the progress of anadromous fish from the Atlantic to the bottom of the Gulf of Mexico. With reference to physical geography, Newfoundland appears as a prolongation of the Atlantic coast line, and its zoological and botanical productions correspond to those of Labrador. When the canals already projected shall have opened a communication between the several great inland seas which exist in North America, an interchange will take place between the fish of widely diverging waters. The great proportion of water to land forms a striking feature of the north-east continent. This may be zoologically divided into two districts, viz. the northern or barren grounds, and the southern or wooded. The temperature is here materially influenced by the inland sea of Hudson's Straits, and thus its capability of supporting animal life much affected. On the west of the Rocky Mountains, the northern corner appears to be similar to the eastern side or barren grounds. The general character of the country bordering the Pacific is mountainous. With respect to the climate of North America, the eastern coast has a lower mean temperature than the western, at least in the higher latitudes. Probably the isothermal, and even the isothæral lines of the banks of the Columbia and New Caledonia, correspond nearly in latitude with those of the east coast of Europe. But on the eastern side down to the 56th parallel of latitude, the subsoil is perpetually frozen. Even in the 45th parallel, on the north side of the great Canada lakes, there is upwards of six months of continuous frost, and the grallatorial, and

most of the graminivorous birds, can find nothing to support them in the winter season; and, consequently, the migration of the feathered tribes is here much more general than in the countries of Europe lying under the same parallel. The principal cause of this great difference between the climates of the eastern and western districts, may be ascribed to the configuration of the coast land, which detains the ice in its bays and gulfs, and this, in melting, materially depresses the summer heat. The decrement in the mean annual heat, corresponding to the increase in latitude, is greater in North America than in Europe, and there exists a wider difference between the temperatures of summer and winter. Dr. Richardson then concluded this introductory portion of his report, by details concerning the temperatures which had been observed at different places in the country under consideration.

Mr. Rootsey exhibited specimens of sugar, malt, and an ardent spirit, which he had extracted from mangel wurzel, and considered that this root might, under certain circumstances, be grown to great advantage in this country, for the purposes of manufacturing the above articles.

Mr. G. Webb Hall read a communication "On the Acceleration of the Growth of Wheat." After pointing out the advantages which might accrue to agriculture from the attention given by scientific men to certain subjects with which it was connected; and the absolute necessity which now existed for making the most extensive and careful investigations concerning many points of great importance to the success of agriculture, he proceeded to call the attention of the Section to a statement of facts, by which it would be seen that the usual period allotted to the occupation of the ground for a crop of wheat might be very materially abridged. At an average, this might be estimated at ten months, though twelve, and even thirteen, were not unusual, and eight might be considered as the shortest period for the ordinary winter wheat. By a selection of particular seed, and a choice of peculiar situation, wheat sown early in March has been, on different occasions, ripened before the middle of August, a period scarcely exceeding five months. Mr. Hall considers it an unquestionable law of vegetation, that the offspring of a plant of early maturity itself, seeks to become so likewise, even when placed in unpropitious circumstances, and that it recedes with reluctance from the condition of its parent. Hence the seed of a crop which has been ripened in five months has a better prospect of producing

another crop equally accelerated, than that from a crop which has been longer in ripening. He also asserted, that the acceleration of a crop was farther promoted by thick sowing, which likewise might be considered advantageous in checking and stopping the mildew.—Dr. Richardson referred to the remark of Humboldt, that in South America the wheat crop was ripened in ninety days from the period of sowing, and stated, that about Hudson's Bay this period was only seventy days. He suggested the probable advantage that might arise from importing seed from the latter country for the purpose of furthering Mr. Hall's views; but this gentleman stated, that he had found that seed imported from a distance (and he had tried some from Italy) was liable to become diseased. As connected with the subject of the acceleration of the growth of seeds, Prof. Henslow mentioned the results of experiments which he had tried upon seeds of a species of Acacia, sent by Sir John Herschel from the Cape of Good Hope, with directions that they should be steeped in boiling water before they were sown. Some of these were kept at the boiling temperature for three, six, and fifteen minutes respectively, and had yet germinated very readily in the open border; whilst those which had not been steeped did not vegetate. It was suggested that these facts might lead to beneficial results, by shewing agriculturists that they may possibly be able to steep various seeds in water sufficiently heated to destroy certain fungi or insects known to be destructive to them without injuring the vital principle in the seed itself.—Mr. Hope mentioned a practice common in some parts of Spain, of baking corn to a certain extent, by exposing it to a temperature of 150° or upwards, for the purpose of destroying an insect by which it was liable to be attacked.—Dr. Richardson mentioned, that the seeds sold in China for the European market were previously boiled, for the purpose of destroying their vitality, as the jealousy of that people made them anxious to prevent their exportation in a state fitted for germination. Upon sowing these seeds he had nevertheless observed some few of them were still capable of vegetating.

Mr. Curtis exhibited some specimens of the terminal shoots of a Pinus, which had been attacked by the *Hylurgus piniperda*, and made a few remarks on the habits of the insect.

Dr. Daubeny communicated to the Section the partial results which he had obtained from a series of experiments he was carrying on at Oxford, respecting the effects which arsenic produces on vege-

tation. He was led to undertake these experiments from having received a communication from Mr. Davies Gilbert, in which he stated that there was a district in Cornwall where the soil contained a large proportion of arsenic; and that no plants could grow in it except some of the Leguminosæ. By analysis, this soil yielded him about fifty per cent. of arsenic, in the form of a sulphuret; the rest being composed principally of sulphuret of iron and a little silica. He had already ascertained that a little of the sulphuret mixed in soils produced no injurious effect on *Sinapis alba*, barley, or beans; and that they flowered and seeded freely when grown in it. Although the want of solubility in the sulphuret might be assigned as a reason for its inactivity; yet it was certainly taken up by water in small quantities, and imbibed by the roots of plants. Upon watering them with a solution of arsenious acid, he found that they would bear it in larger proportions than was presupposed. The injurious effects of arsenious acid on vegetation in the neighborhood of the copper-works of Bristol and Swansea, was noticed by Mr. Rootsey; and Mr. Stevens mentioned the circumstance of the trout in some streams of Cornwall having been destroyed by the opening of some new mines in their neighborhood, from which arsenical compounds were discharged, though the vegetation did not appear to be injured by them; and it was further stated, that horses were considerably injured, and rendered subject to a remarkable disease, by the effects of arsenical compounds in the same districts.

SECTION E.—ANATOMY AND MEDICINE.

President—Dr. Roget.
Vice Presidents—Dr. Bright, Dr. Macartney.
Secretaries—Dr. Symonds, G. D. Fripp, Esq.

Dr. O'Beirne read a Report of the Dublin Committee on the pathology of the nervous system.

A short description of a case of aneurism of the arteria innominata, furnished by Sir D. H. Dickson, was then read.

SECTION F.—STATISTICS.

President—Sir Charles Lemon, Bart.
Vice Presidents—H. Hallam, Esq., Dr. Jerrard.
Secretaries—Rev. J. E. Bromby, C. B. Fripp, Esq., James Heywood, Esq.

A very curious and interesting report was read, entitled, "A few statistical facts, descriptive of the former and present state of Glasgow," by James Cleland, LL. D.

Section G.—Mechanical Science.

President—Davies Gilbert, Esq.

Vice Presidents—M. I. Brunel, Esq., John Robison, Esq.

Secretaries—T. G. Bunt, Esq., G. T. Clark, Esq., William West, Esq.

The discussions were opened by some observations of Professor Moseley on the theory of locomotive carriages.

Dr. Lardner next laid before the meeting many details in regard to Railroads. Afterwards Mr. Russell of Edinburgh read an important memoir on the traction of boats in canals at different velocities.

Tuesday, August 23.

Section A.—Mathematics and Physical Science.

Mr. Russell gave an interesting statement of a series of experiments regarding the laws of the Motions of Waves excited in Water.

Prof. Powell read a paper respecting the Refractive Indices of several Substances.

A paper was then read, contributed by Sir D. Brewster, "On the Polarizing Structure of the Crystalline Lens of the Eyes of Animals after Death."

The Rev. J. W. M'Gauley read an account of "A Series of Experiments in Electro-Magnetism, with reference to its application as a Moving Power."

Section B.—Chemistry and Mineralogy.

Mr. Exley read a very interesting memoir on a new theory of chemical combination, deduced from mathematical data, and demonstrated mathematically.

Dr. Charles Henry read an account of some experiments made with a view to determine the mode in which certain gases act in preventing the action of spongy platinum upon a mixture of oxygen and hydrogen. The gases he examined were carbonic oxide and olefiant gas. He found that carbonic oxide was the most powerful, and that carbonic acid was always the result. Hence it is evident that oxygen and hydrogen are prevented from combining by the superior attraction of the carbonic oxide for the oxygen. Olefiant gas he found not to be decomposed, and hence the attraction which pre-

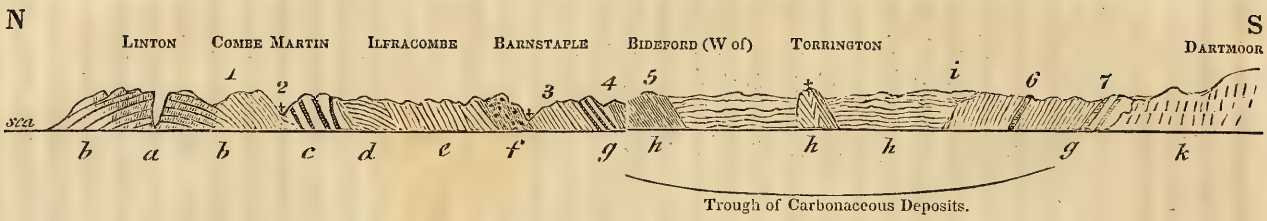
vents the combination is not sufficiently powerful to form any other. This explanation is corroborated by the fact, that it requires a very great proportion of the olefiant gas to produce the effect.

Mr. Herapath then read a paper on Arsenical Poisons.

Section C.—Geology and Geography.

The first paper was "A Classification of the Old Slate Rocks of Devonshire, and on the true position of the Culm Deposits of the central portion of that country," by Professor Sedgwick and Mr. Murchison.—The authors began by observing, that this was a mere outline of a more detailed memoir on the physical structure of Devonshire, which they were about to lay before the Geological Society of London. In the published geological maps of that county, the whole system of the older slate rocks was represented under one color, without any attempt at subdivision; and one color also represented different limestones, without any discrimination. The object of the authors was, to remedy these defects,—to ascertain and represent the true position of the successive deposits and their natural subdivisions, so as to compare them with corresponding deposits in other places. They also wished to determine the true place of the remarkable carbonaceous deposits of central Devon, which had been previously regarded as belonging to the lowest portion of the grauwacke formation. A section was exhibited of part of that county, from the north coast to one of the granite peaks of Dartmoor immediately southwest of Oakhampton. A diagram of the section will be found on the succeeding page.

In the ascending order this section exhibits—1. A system of slaty rocks, containing a vast abundance of organic remains, generally in the form of casts. These rocks sometimes pass into a fine glossy clay slate, with a true transverse cleavage; sometimes into a hard quartzose flagstone, not unusually of a reddish tinge; sometimes into a reddish sandstone, subordinate to which are beds of incoherent shale. In North Devon they are very rarely so calcareous as to be burnt for lime, but in South Devon, rocks of the same age appear to be much more calcareous.—2. A series of rocks characterized by hard thick-bedded red sandstone, and red micaceous flagstone, subordinate to which are bands of red, purple, and variegated shales. The red color occasionally disappears, and the formation puts on the ordinary appearance of a coarse, siliceous grauwacke, subordinate to which are some bands of imperfect roofing slate. In



ASCENDING SERIES OF DEVONIAN ROCKS.

Cambrian Rocks.	(*a*) Slaty schists, with some calcareous courses and organic remains.
	(*b*) Purple, red, and grey sandstones, with beds of iron ore in upper members—peculiar fossils near their junction with the overlying limestones. Veins of lead and copper.
Upper Cambrian or Devonian Rocks.	(*c*) Calcareous group of Combe Martin and Ilfracombe—fossils very abundant—slaty cleavage.
	(*d*) Slates with quartzose veins and beds—incoherent schists, &c. Manganese mines.
Silurian Rocks.	(*e*) Slaty sandstones and schists—cleavage passing through the beds of organic remains.
	(*f*) Ditto, with concretionary limestones, and many well known Silurian fossils, chiefly of the lower part of the system.
Culm Deposits = Coal fields of Pembroke.	(*g*) Culmiferous or black limestone, with portions of stone coal, and fossils distinct from any found in the inferior groups. Wavellite occurs in the beds below this limestone.
	(*h*) Culm beds with underlying and overlying successions of sandstone and shale often highly pyritous, with many nodules of iron ore, frequently containing coal plants, and never affected like the older rocks by slaty cleavage.
	(*i*) New red sandstone resting unconformably on the carbonaceous deposits.
	(*k*) Granite of Dartmoor and Elvan Dyke, both erupted through the culm deposits.

REFERENCES.—1. Beds of Iron ore.—2. Lead ore.—3. Wavellite.—4. (plants.)—5. Culm.—6. Elvan Dyke.—7. (plants.)

this series are very few organic remains. It is several feet in thickness, occupying the whole coast from the west end of the Valley of Rocks to Combe Martin.—3. The calcareous slates of Combe Martin and Ilfracombe, of very great aggregate thickness, abounding in organic remains, and containing in a part of their range at least nine distinct ribs of limestone burnt for use. This limestone is prolonged into Somersetshire, and appears to be the equivalent of that on the flanks of the Quantock Hills.—4. A formation of greenish and lead-colored roofing slate of great thickness, and occupying a well defined zone in North Devon, its upper bed alternating with and gradually passing into a great deposit of sandstones of various colors and micaceous flagstones. These siliceous masses alternate with incoherent slates, and are in some places surmounted by great masses of red unctuous shale, which, when in a more solid form, generally exhibit cleavage oblique to the stratification.—5. The Silurian system resting conformably on the preceding, and of great thickness, on the north-western coast, containing many subordinate beds and masses of limestone. In its range towards the eastern part of the county, it gradually thins off, but its characters are well preserved, and it every where contains vast numbers of characteristic organic remains.—6. The carbonaceous system of Devonshire, in a direction east and west across the county, in its southern boundary so close to Dartmoor that its lower beds have been tilted up and altered by the granite. It occupies a trough, the northern border of which rests, partly in a conformable position upon the Silurian system, and partly upon older rocks, probably of the division No. 4. Its southern border also rests on the slate rocks of Launceston. It every where exhibits a succession of violent contortions. In some places it is overlaid by patches of green sand, and west of Bideford by conglomerates of the new red sandstone. The lowest portion of this vast deposit is generally thin bedded, sometimes composed of sandstone and shale, with impressions of plants, sometimes of indurated compact slate, containing wavellite. These beds are surmounted by alternations of shale and dark colored limestone with a few fossils. Subordinate to these, there are on the western side of the county thin veins and flakes of culm or anthracite; but this is wanting on the eastern side, and the calcareous beds are more expanded. The higher beds of this deposit are well exhibited on the coast west of Bideford. These often contain impressions of vegetables. Though in a state of greater induration than the ordinary coal measures of England, and even in

many places destitute of any trace of coal, still these beds do not differ from the great unproductive coal-field of Pembrokeshire. The authors consequently concluded, that from the order of superposition,—from mineral structure—from absence of slaty cleavage peculiar to the older rocks on which this deposit rests, and from the specific character of its organic remains, it may without hesitation be referred to the regular carboniferous series. In the course of the details, the authors alluded to a remarkable elevated beach, occupying two miles of coast on the north side of Barnstaple Bay, a more special account of which is being prepared for the Geological Society.

M. De la Beche objected to the conclusions of Messrs. Sedgwick and Murchison, although he did not dispute the correctness of the section of the country which they had exhibited to the meeting. He conceived that he had traced the carbonaceous rocks passing into what had been termed the Cambrian system, although he was not prepared to say that it really was that system. He was also unable to make that separation of the contorted rocks, suggested by the authors of the paper. He spoke of the overlying greenstones in different places, and considered that these were of different ages; also of the changes produced by granite on rocks of every kind in contact with it. He alluded to the former opinions of the rocks called by the general name, Greywacke, which opinions have, of late years, been totally altered. He attached very little importance to mineral characters: unless the consideration of the imbedded organic remains was made of the first importance, we were sure of falling into error. Are the organic remains in these carbonaceous rocks of Devon really the same as those of the general carboniferous system? He stated, that he conceived there was evidence to prove that there was a regular band of rocks surrounding Dartmoor, which had been thrust up through the hollow in the middle. He could nowhere discover any line of separation between the carbonaceous and the older rocks, so that he was unable to reconcile the deposits of coal with those of other parts of England, and as to the age of these older rocks all were agreed. In the Alps, organic remains of the coal formation are found in beds, alternating with oolites, so that we must not limit too strictly the range of these organic remains, as we should be certain of all the conditions under which coal plants can be accumulated. We should recollect, that the remains of the vegetation of a mountain may be entombed at its base, so as to be shifted from its original habitat; and that, although

the disposition of organic remains may hold true for a certain extent of the earth's surface, we have no right to consider such a disposition universal.—Mr. Sedgwick remarked, that he could with certainty distinguish four calcareous zones in North Devon—viz. one at Linton, a second at Ilfracombe, and two others at Barnstaple. The difference of the limestones of South Devon was also very remarkable; that of Plymouth being essentially distinct from that of Dartmoor. These carbonaceous strata also extended several miles into Cornwall.—Mr. Conybeare considered that the public had exaggerated the difference of opinion then before the meeting. He was rather inclined to coincide with Messrs. Sedgwick and Murchison in considering the strata in dispute as referable to the general carboniferous system, and from the general resemblance of the formations to those of Pembrokeshire, the probability was much strengthened.—Prof. Phillips conceived that it had been satisfactorily proved, that there existed a coal basin in the interior of Devonshire, although, at first sight, from the unprofitable nature of the contained coal, being the kind called Culm, some hesitation might have taken place as to assigning it its true position. But doubts must vanish on inspecting the organic remains: and here he might observe, that it was a mistake to suppose that Dr. Smith, the founder of English geology, had ever intended to limit the range of these remains as some had accused him of. We might readily assume, and observation has confirmed, that some organic remains of one stratum may be found in contiguous strata, associated with fossils of different kinds, so that organic remains alone are insufficient to point out distinctions in strata. But the general appearance of the limestones of Devon was precisely similar to those of the north of England, in regard both of mineral character and imbedded fossils. From their appearance, he had expected their interstratification with shales, and Mr. Murchison had confirmed this supposition. The Devon limestone corresponded indeed with the upper bed of the Yorkshire limestone; in the former he had detected a shell, a species of Anodon, which he had not observed in the latter; but the species of Posidonia found in both exactly correspond. Perhaps one cause of mistake might have been the little attention paid to the black limestone of Craven, by Mr. Conybeare, and to this limestone there was a most striking resemblance in the black variety of Devonshire. He alluded to the extraordinary anomaly of coal plants having been found in the Alps, associated with oolites, but this might be an exception from the general law, and

exceptions there must be ; still it must be allowed, that organic life must have a constant relation to the state of the actual surface. He came to the conclusion, that the Devon district would not offer any anomaly in geological arrangement, but that it would correspond in arrangement with the other parts of the country, and that a fruitful source of error is the hitherto vague term Greywacke, which has been applied indiscriminately to a great variety of rocks, so as to include many of different ages throughout this county.—Dr. Buckland congratulated the meeting on the difference of opinion among the geologists present, such a difference producing discussion, which was the sure means of arriving at truth. He considered, that the true solution of the question at issue would be in the middle course ; that, no doubt, it could not be easily granted, that the series under consideration was carboniferous, when no true coal was contained in it ; but, were we to adopt the new term, *culmiferous*, we should get rid of the difficulty. This culmiferous series he regarded as the lowest portion of the coal formation, and as resting upon the Silurian rocks. He alluded to the difficulty of making geological maps ; these must be constantly modified, according to the extent of investigation : errors of omission must be committed by every pioneer in geology, which can be corrected only by the researches of succeeding observers.

After the discussion was closed, Mr. De la Beche exhibited a part of the Ordnance Geological Map of Devon, and such parts of that of Cornwall as have been finished ; and pointed out the general parallelism of certain great lines of dislocation both in the metalliferous and non-metalliferous districts. He stated that he considered such lines to have been produced at the same geological epoch, and attributed the fact of the occurrence of the ores of useful metals in some situations and not in others, to conditions which were to be found in the one and not in the other. The conditions most favorable to the occurrence of the tin and copper ores of Cornwall and Devon, are the proximity to the junction lines of the granitic and slate systems of those counties ; the intermixture of granitic and porphyritic dykes with the slates, or with the masses of granite ; the occurrence of great lines of dislocation traversing the lodes or mineral veins, and termed *cross courses*, &c. The author pointed out numerous other conditions, and then noticed the beneficial effects of the proximity of the granitic or porphyritic dykes provincially termed *elvans*, and which alike traverse the

granitic and the slate systems. In support of this view, he instanced more particularly the mines in the vicinity of Marazion, where the lodes or mineral veins traverse lines of elvans obliquely, and where very rich bunches of ore have been obtained at such junctions. Indeed the miners of that part of the country are perfectly aware of the value of these junctions, and carry their work on as much as possible within their favorable influence. The author directed the attention of the Section to the fact, that all the great mines of Cornwall are situated amid the above conditions, and to the advantages which geology could thus confer upon the community, by pointing out to them those places where the chances are favorable to mining operations, and by inducing them to avoid those bubble speculations at this moment so unfortunately common.—Mr. Hopkins was called upon to make some observations regarding the direction of the fissures mentioned by Mr. De la Beche, but he did not enter very fully into any discussion, as he proposed, on the following day, to bring the general consideration of fissures before the Section. He observed, however, that there must have been one great axis of disturbance, to which the smaller fissures must either have been parallel, or have circulated around it; indeed, Mr. De la Beche has supposed the great line of fissures from Blackdown to Cornwall had been curved by the intervening granites. He stated, that there must be a connexion between the width of lodes and their mineral contents; also, that in the production of fissures there must have been several periods of elevation.—Mr. Fox then mentioned a remarkable experiment which he had made upon the yellow sulphuret of copper, having changed it by electricity into the grey sulphuret. In a trough a mass of clay was placed, so as to divide it into two portions, in one of which was sulphate of copper in solution, in the other dilute sulphuric acid. On the electric communication being made by placing the yellow sulphuret in the solution of sulphate of copper, and a piece of zinc in the acid, the change of sulphuret took place, and crystals of native copper were also formed upon it.—Mr. Fox observed, that native copper is not found in the mines of Cornwall combined with yellow copper, but with black copper ore; and that the grey ore is generally found nearer the surface than the yellow, and also in and near the cross courses.—Mr. Taylor bore testimony to the importance of geological information to mining agents, who now were informing themselves, not only in practice but in theory. He spoke of the exertions of the

late Mr. Phillips, in drawing up a geological map of Cornwall, so far back as 1800. He suggested the propriety of tracing the lines of fissures into the coal districts, and also wished the directions of the lead lodes of the mountain limestone to be ascertained, as likely to lead to general results.

SECTION D.—ZOOLOGY AND BOTANY.

Dr. Richardson resumed the reading of his Report on the Zoology of North America. In touching upon the geographical distribution of the Mammalia, he remarked the great similarity which existed between them and the European species; whilst there was the greatest dissimilarity to those of South America. The boundary line separating the Faunas of North and South America, was not at the Isthmus of Darien, but at the tropic of Cancer. No Quadrumana occur to the north of the Isthmus of Darien; though in Europe there is a species which ranges as far north as the rock of Gibraltar, in latitude 36°.—In the order Carnivora, and family Cheiroptera, all the North American species belong to that tribe which possesses only one bony phalanx in the index, and two in each of the other fingers, to which tribe also all the European bats belong, except an Italian species of Dinops. None of the sixteen species recorded as natives of North America have been found elsewhere; two only have been traced over any great extent of country, and one of these (resembling the European Pipistrellus) ranges through 24° of latitude, and is the most northerly species in America. There must be still many bats to be discovered in that country, as those of Mexico, California, and the whole track of the Rocky Mountains are entirely unknown. Of the family Insectivora, ten species were enumerated; and it was stated that North America differs more from Europe in this family, than in any other of the order Carnivora. Three of the European genera do not exist in North America, and the three genera found in North America do not exist in South America. The North American species of Sorex, however, closely resemble those of Europe.—Of the family Marsupiata, inhabiting the New World, only three species reach into North America, the rest being confined to the south of the Isthmus of Darien. Two of these occur no higher than Mexico; but the third (the Virginian opossum) ranges to the great Canadian lakes on the north, and to Paraguay on the south.—About forty species of the family Carnivora have been noticed; and this family includes a greater number than any other

which are common to both North America and Europe; though possibly a closer acquaintance with some which are at present considered identical, may enable us to establish some distinction between them. The generic forms of North America are the same as those of Europe, excepting in a very few cases, which belong to the South American group. A few of the more northern forms also cross the Isthmus of Darien to the south.—In the family of Plantigrada, two of the four bears of North America are undoubtedly peculiar to the New World; and one of these is the most northerly quadruped it contains. The American Glutton, or Wolverine according to Cuvier, is identical with that of the Old World. Among the Digitigrada, the range of the Mustelæ is limited southwards to the northern or middle district of the United States. Whether any of the American and European species of this genus be really identical, is involved in great uncertainty. Of the three otters of North America, one appears to be identical with that of Europe; and another, if correctly identified as the *Lutra Brasiliensis*, has a most extensive range, from the Arctic Sea through great part of South America. Eight species of the genus Canis are found in North America; but there is great difficulty in distinguishing the species, and in identifying them with any of those of Europe. The domestic dog breeds with the wolf and fox, and their offspring is prolific. Eight species of the genus Felis were mentioned by Dr. Richardson, three of which extend from South America into the south western territories of the United States; and some of the others are still doubtful as North American species. The nine species of Amphibia found in North America, are mostly common to the northern seas of the Old and New Worlds; the genus Otaria alone being confined to the North Pacific; and even these range to the Asiatic coast. The specific identity of some of the seals is involved in very great doubt. In the order Rodentia, there have been between seventy and eighty species discovered; and here North America surpasses every quarter of the globe in the abundance and variety of form which these animals assume. The squirrels are not yet satisfactorily determined. The marmots are numerous, except in the subgenus Spermophilus. There is only one which may possibly be common to the New and Old World. There is only one of the restricted genus Mus, which is unequivocally indigenous to North America; and this closely resembles the European *M. sylvestris*. Other species have been introduced from the opposite side of the Atlantic.

Mr. Bowman read a communication respecting the longevity of the yew tree; and mentioned the result of his observations upon the growth of several young trees, by which it appeared that their diameters increased during the first one hundred and twenty years, at the rate of at least two lines, or the one sixth of an inch per annum; and that under favorable circumstances the growth was still more rapid. In the church yard at Gresford, near Wrexham, North Wales, are eighteen yew trees, which are stated by the parish register for 1726 to have been planted that year. The average of the diameters of these trees is twenty inches. Mr. Bowman then remarked on two yew trees of large dimensions, from the trunks of which he had obtained sections. One is in same church yard as those above mentioned, and its trunk is twenty two feet in circumference at the base, twenty nine feet below the first branches. This gives us a mean diameter of 1224 lines, which, according to De Candolle's rule for estimating the age of the yew, ought also to indicate the number of years. From three sections obtained from this tree, Mr. Bowman ascertained that the average number of rings deposited for one inch in depth of its latest growth, was $34\frac{2}{3}$. Comparing this with the data obtained from the eighteen young trees, he estimated the probable age of this tree at 1419 years. The second of these trees is in the church yard of Darley in the Dale, Derbyshire, and its mean diameter, taken from measurements at four different places, in 1356 lines. Horizontal sections from its north and south sides gave an average for its latest increase at forty four rings per inch nearly, which gives two thousand and six years as its age, by the mode of calculation adopted by Mr. Bowman. He then proceeded to state his opinion of the reason why so many old yew trees were to be met with in church yards: he considered that they might have been planted there at a period anterior to the introduction of christianity, under the influence of the same feelings as those which prompted the early nations of antiquity to plant the cypress round the graves of their deceased friends.

Mr. Ball exhibited the skulls of a species of seal common in Ireland with a view of eliciting information, as he considered it to be new to the British Fauna, and very distinct from the two already recorded. The present species was never known to become tame, whilst the *Phoca vitulina*, generally considered the more common species of our coasts, was very easily tamed.—Prof. Nilsson, of Lund, at once pronounced this species to be his *Haliochœrus griseus*,

forming a distinct genus from *Phoca*, and described by him in the year 1820. It had been previously recorded by Fabricius, under the name of *Phoca gryphus*. It is common in the Baltic and North sea, and to be met with in Iceland, and attains a size of eight feet in length. In Sweden it was emphatically termed the sea seal in contradistinction to those which inhabited gulfs. He remarked that the name of *Phoca vitulina* had been applied by Linnæus, and subsequent authors, to three distinct species, to which he had himself given the names of *barbata*, *variegata*, and *annellata*. Of these he had ascertained that a specimen captured in the Severn, and now in the Bristol Institution, belonged to the *annellata*.—Dr. Scoular remarked that the species which Prof. Nilsson had identified as his *Haliochœrus griseus*, predominated in Ireland over the *Phoca vitulina*, though it had been hitherto neglected; and that the great difference in the teeth of these species, justly entitled them to be considered as forming distinct genera.—Dr. Riley exhibited the stomach of the specimen alluded to, as having been caught in the Severn, in which he had found from thirty to forty pebbles, and states that other instances had occurred of a similar nature; and that it was a popular notion that they assisted the seal in the way of ballast whilst catching his prey, which it did by rising vertically upwards, and seizing it from below. But Sir Francis Mackenzie then asserted that he had repeatedly seen the seal chase salmon into the nets, and that it was not usual for it to capture its prey in the way described. Neither he nor Prof. Nilsson, nor Mr. Ball, had ever found stones in the stomach of this animal.

Dr. Hancock read a paper on a new species of Norantea, from Guiana, termed by the natives Corocoromibi.

Mr. Hope exhibited a remarkable specimen of the *Lucanus camelus*, Fabr., from North America, the right side of which had the configuration of the male, and the left of the female sex.

Mr. Hope read a communication, expressive of the probability that some of the early notions of antiquity were derived from observations made on the habits of insects.

Mr. P. Duncan offered a few remarks upon the subject of Mr. Hope's speculations.

Mr. G. Webb Hall commented on the effects of lime as variously applied to different soils.

Section E.—Anatomy and Medicine.

The first paper read was entitled, "Observations on Remedies for Diseases of the Brain," by Dr. Prichard, of Bristol.

The second paper read was by Dr. Houston, on a human fœtus without heart or lungs.

The third paper was by R. Carmichael, Esq. on Tubercles.

Section F.—Statistics.

Mr. Kingsley presented and described several forms of tables, for more accurately displaying the revenue and expenditure of the United Kingdom, and procuring accuracy in Parlimentary returns of the state of Savings Banks, &c.

Baron Dupin addressed the Section on the subject of a paper he had laid upon the table, entitled, "Researches relative to the price of grain, and its influence on the French population."

Section G.—Mechanical Science.

The sitting of the Section occupied but a short time, during which two papers were read, one of some interest, by Mr. Henwood, on Naval Architecture, and a second by Mr. Coosham, on certain improvements in Napier's rods. Dr. Daubeny also exhibited an ingenious instrument for taking up sea water from any given depth, for the purpose of chemical analysis, being an improvement of an admirable invention for that purpose sent out in the Bonite.

Evening Meetings.—In consequence of the incessant rain, the intended promenade and horticultural exhibition at Miller's gardens, was abandoned, and notice given that the Geological, Statistical and Mechanical Sections, would meet in the evening.

In the Geological Section, Dr. Hare of Philadelphia entered upon a history of the many modifications of the pile of Volta, and in particular drew attention to a form of it devised, and long since described by himself, but which he conceived had not in a sufficient degree attracted the attention of European philosophers. Dr. Hare concluded by the exhibition of some striking experiments illustrative of the igniting or deflagrating efficacy of his Voltaic arrangements.

Prof. Phillips followed with an account of the distribution over the northern parts of England of blocks or boulders. The Association, he observed, had formerly proposed a question regarding this distribution, and the present was a partial attempt at its solution; and it was interesting both to the geologist and the geographer, as it

involved the effects of running water in modifying the surface of a country. In glancing over the north of England, we find a great variety of rock formations, from the oldest slates to the newer tertiary; the country generally slopes to the east, with the exception of the group of Cumbrian mountains, which form a local conical zone. One striking feature in its physical geography, is an immense valley running north and south, and passing through a great variety of formations; the Wolds of York being chalk, the strata near Whitby of oolite, the vale of York new red sandstone, while the carboniferous rocks are displayed in Northumberland and Durham. All the country from the Tyne to the Humber is covered with transported boulders, many of which are of rocks quite different from any near the spots where they occur, and some even not recognizable as British rocks. Could Mr. Lyell's ideas regarding the office of icebergs be true, that they had been the means of transporting gravel to distant places—boulders of the Shap Fell granite had been found in the south-eastern part of Yorkshire; in the interior, there were great accumulations of them in many places, their directions seemed all to converge to a certain point, in what is termed the Pennine chain, but on this chain no boulders have been observed, except at one point, from which you look towards Shap Fell; towards the north they have been drifted nearly as far as Carlisle, but there is no trace of them towards the west. We also find boulders from Carrick Fell carried to Newcastle and the Yorkshire coast, and these have been drifted over the same point of Stainmoor. Mr. Phillips gave several conflicting opinions of different geologists, to account for this extraordinary transportation: the bursting of the banks of lakes; the alternate elevation and depression of mountain chains; and the supposition that the entire country had been under the sea, when the distribution of boulders had taken place.—Mr. Sedgwick then rose, and remarked, that the direction of transport of the blocks may have been modified by the surface over which they were carried; and that Sir James Hall had been the first who had observed the Shap Fell boulders. These boulders Mr. Sedgwick had noticed on the shores of the Solway Firth, mixed with gravel from Dumfries-shire. He alluded to the action of water upon the crests of mountains, and to the occurrence of transported blocks at considerable elevations. It was well known that mountain lakes were gradually filling up; and he had shewn in a paper to the Geological Society, the relation of a lake to the age of the valley containing it.

With the diluvial gravel over the country we find associated organic remains,—a strong proof that the land must have been dry when the transportation took place.—Mr. Murchison had observed these boulders associated with recent shells at various elevations,—consequently, the land must have been at one time under the sea, and have been subsequently elevated. There must have been a relative change of the level of land and sea; and Prof. Esmark, in Norway, had been the originator of the idea of the icebergs transporting gravel. He referred to the valley of the Inn, in the Tyrolese Alps, as illustrating this alteration of level: boulders of granite had been found on calcareous mountains composing one of its sides, elevated five or six thousand feet above the sea level; and this valley could not have been scooped out.—Dr. Buckland was of opinion that the land must have been dry before the action of the water that had transported these blocks. There was a great number of organic remains mixed with the gravel derived from animals existing on dry land; and this was not only true in England, but confirmed by observations made on the continent of Europe.

In the Statistical Section Dr. Lardner delivered a lecture on steam communication with India.

In the Section of Mechanical Science, Mr. Whewell gave a short account of the present state of the science of the tides. Though there can be no doubt, that the tides are to be reckoned among the results of the great law of universal gravitation, they differ from all the other results of that law in this respect, that the facts have not, *in their details*, been reduced to an accordance with the theory; and the peculiar interest of the subject at the present moment arises from this, that the researches now going on appear to be tending to an accordance of theory and observation; although much in the way of calculation and observation remains to be still effected before this accordance reaches its ultimate state of completeness. With regard to observation, the port of Bristol offers peculiar advantages; for, in consequence of the great magnitude of the tides there, almost all the peculiarities of the phenomena are magnified, and may be studied as if under a microscope. With regard to the theory, one point mainly was dwelt upon. By the theory, the tides follow the moon's *southings* at a certain interval of time, (the *lunitidal* interval,) and this mean interval will undergo changes, so as to leave less than the mean when the moon passes three hours after the sun, equal to the mean when the moon passes six hours after the sun, and greater

than the mean when the moon passes nine hours after the sun; and the quantity by which the lunitidal interval is less than the mean when the moon is three hours after the sun, is exactly equal to the quantity by which the lunitidal interval is greater than the mean when the moon passes nine hours after the sun. And this equality of the defect and excess of the interval at three hours and at nine hours of the moon's transit, is still true where the moon's force alters by the alteration of her parallax or declination. Now we are to inquire whether this equality of excess and defect of the interval in all changes of declination, &c., is exhibited by observation. It appears at first sight, that the equality does not exist; that is, if we obtain the lunitidal interval by comparing the tide with the *nearest* preceding transit. But, in truth, we ought not to refer the tide to such a transit, because we know that the tide of our shores must be produced in a great measure by the tide which revolves in the Southern Ocean, and which every half day sends off tides along the Atlantic. The tide, therefore, which reaches Bristol, is the result of a tide wave, which was produced by the action of the sun and moon at some anterior period. It is found, that if at Bristol we refer each tide to the transit of the moon, which took place about forty four hours previously, we do obtain an accordance of the observations with theory in the feature above described,—that although the moon's force alters by the alteration of her declination, the defect of the lunitidal interval for a three hours' transit of the moon is equal to the excess of that interval for a nine hours' transit. And thus, in this respect at least, the tide at Bristol agrees exactly with the tide which would be produced, if, forty four hours before the tide, the waters of the ocean assumed the form of the spheroid of equilibrium due to the forces of the moon and sun, and if this tide were transmitted unaltered to Bristol in those forty four hours.

Wednesday, Aug. 24.

Section A.—Mathematical and Physical Science.

The first paper read was by Mr. W. Snow Harris, "On some phenomena of electrical repulsion."

Prof. Challis read his "Supplementary report upon the mathematical theory of fluids."

Prof. Stevelly gave his "Illustration of the meaning of the doubtful algebraic sign in certain formulæ of algebraic geometry."

Prof. M'Cullagh made a communication respecting the laws of double refraction in crystals of quartz.

Mr. R. Addams then made a communication on the interference of sound, and illustrated his subject by several experiments.

Section B.—Chemistry and Mineralogy.

Dr. Daubeny read an interesting report on the present state of our knowledge with respect to mineral waters.

Mr. Mushet exhibited some specimens of metallic iron, prepared by exposing the iron ore to long continued heat, with a small quantity of fuel, and thus reducing it to the metallic state without fusion.

Mr. Johnston described paracyanogen and its compounds.

Mr. West next read a short paper, the object of which was to suggest a new mode of determining the presence, and estimating the amount, of those materials which constitute but small fractional portions of the atmosphere. His proposition was, that instead of operating upon a limited volume of air, as is usually done, a very large quantity of it should be made by mechanical means to pass through appropriate fluids—such as barytic water for carbonic acid, and nitrate of silver when the object was to determine the presence of muriatic acid.—Dr. Dalton stated that he had for many years turned his attention to the amount of carbonic acid in the atmosphere, and that he had satisfied himself that its average quantity was one part in 1100. He altogether rejected the results of Saussure, and contended that the quantity of this gas in the atmosphere was constantly the same in town and country; and that even in a crowded theatre it seldom rises to one per cent.—Dr. Thomson gave it as his opinion, that a fall of rain diminished the amount of carbonic acid in the air, and expressed surprise that Dr. Dalton should maintain an opposite tenet.

The business of the day was concluded by Dr. Hare reading a pamphlet on the Berzelian nomenclature, which he addressed some years since to Prof. Silliman.

Section C.—Geology and Geography.

Mr. Stutchbury read a paper by himself and Dr. Riley, on some newly discovered saurian remains, from the magnesian conglomerate of Durdham Down. This communication chiefly related to the specimens exhibited to the meeting, and contained a number of minute anatomical details, which testified in a high degree the industry of Dr. Riley and Mr. Stutchbury, who had examined the speci-

mens; but it would be impossible, without plates, to convey to the reader any accurate notion of these highly interesting organic remains. They belong to two new genera established by Dr. Riley and Mr. Stutchbury, the *Palæosaurus* and *Thecodontosaurus;* and were found in the magnesian conglomerate which at Durdham Down reposes on the carboniferous limestone. They must have been deposited upon the spot where they were found without violent action, as they bear no marks of attrition. Perhaps the most interesting fact mentioned, was the peculiar structure of the vertebræ of the newly discovered saurians, which presented a remarkable contrast to those of the recent crocodiles. He shewed a singular gradation from the recent saurians to sauroid fishes, by means of this arrangement of vertebræ, which thus becomes an excellent guide in the discrimination of the saurian animals; and he concluded his communication with a quotation from Agassiz, respecting the progressive development of animal life.—Dr. Riley alluded to the extraordinary structure of the cerebral column of these extinct saurians, as likely to illustrate the supposition of Dr. Gall, that the spinal column of vertebrate would be eventually found to correspond with the ganglionic system of invertebrate animals.—Dr. Buckland was particularly struck with the singular structure of these vertebræ, as indicating in the animal a nervous power of the most extraordinary character.

A paper was read by Mr. Hopkins, containing theoretical views respecting the geological phenomena of elevation. The principal object of the author in this paper, was to investigate the effects of an elevating force acting simultaneously at every point, on portions of the crust of the globe of considerable superficial extent; and to shew that the theoretical inferences deduced from this hypothesis, are in striking accordance with the phenomena he had observed in the limestone and coal districts of Derbyshire. He also proved that in that district the direct cases of dislocation were not such as could result from the influence of the jointed structure as the determining cause of those directions. He pointed out how the theory he had discussed will account for nearly all the phenomena of mineral veins, which can be attributed to mechanical causes; as well as for the formation of systems of anticlinal lines, of faults, and of the phenomena of elevation.—Mr. Sedgwick considered this as the most important communication as yet made to the Section. We should now be enabled to indulge in the same speculations in Geology, as in her

elder sister science Astronomy, and from the beginning now made, it was impossible to predict how far investigations like Mr. Hopkins' might eventually be carried. The observations of Mr. Hopkins held true in Cumberland, Derbyshire, and Flintshire; and some of his cases of complicated dislocation were admirably illustrated in Caernarvon and Stainmoor. Mr. Sedgwick had himself paid particular attention to the joints of rocks, and had found them connected both with their strike and dip. He had also observed some singular phenomena in the Westmoreland slates; he had seen in them two sorts of joints, and a cleavage which was in a different direction from the jointing. In South Wales the planes of splitting were in one direction with very few exceptions.—Mr. Phillips expressed his high satisfaction at the result of Mr. Hopkins' paper, and expressed a hope that the phenomena of geology might, to a certain extent, be explained by such simple laws as regulate the other branches of physical science. With regard to the structure of rocks, which promised to throw so much light upon the subject, he proposed a new term for it, the *symmetrical* structure. In the examination of rocks under the three classes of calcareous, arenaceous, and argillaceous, he had remarked, that the regularity of the structure increased with the antiquity of the rock, which was well exemplified in the older slates and limestones. For this there must be a cause, and this must be a central heat, which has acted most upon the older formations, and least upon the new. Illustrations of the effects of heat upon strata may be obtained from those in contact with dykes, which produce symmetrical structure in rocks or clays through which they pass. Internal heat must then have caused the regular structure so generally observed in rocks. The direction of the fissures pointed out by Mr. Hopkins in Derbyshire, corresponded with the observations of M. De la Beche in Cornwall, and of Mr. Conybeare in Glamorganshire. The phenomena of the direction of the joints were well worth investigation, as there was much uncertainty involved. They evidently pointed out the weaker points, or places of least resistance, where the disturbing force would operate with most effect; and they may have been the result of consolidation, as we find them in conglomerates, as well as in homogeneous rocks; still it might be a question, if they were formed before or after dislocation.

Section D.—Zoology and Botany.

Col. Sykes made a communication to the Section "On the Cultivated and Wild Fruits of the Deccan."

Mr. Mackay read the Report which he had been last year requested to prepare, "On the Geographical Distribution of the Plants of Ireland." This contained a catalogue of one hundred and ninety five of the more remarkable species, with a comparative view of such as were common to the neighborhoods of Dublin, Edinburgh, and the south coast of Scotland. And Mr. Mackay then entered into some details illustrative of the more remarkable points of difference in the vegetation of Ireland and Scotland. This difference might be partly ascribed to the more southerly situation of Ireland, and the height of its mountains being inferior to those of Scotland. Its greater exposure to the influence of the western ocean gives it a moister climate. Scotland is, in consequence, much the richer in alpine plants, and Mr. Mackay enumerated fifty five species of the more remarkable alpine and other plants natives of that country, which do not occur in Ireland. Many plants on the western coast are natives of the mountains of Spain and Portugal. A list was then given, in which twenty one species were enumerated as natives of Ireland, but which had not been found in any other parts of Great Britain, and it was very remarkable that several of these were also to be met with on the western side of the Pyrenees. In conclusion, Mr. Mackay proposed to continue his observations, hoping to present the Association with a more perfect list on a future occasion.

Mr. Royle read a communication on Caoutchouc.

Mr. P. Duncan detailed some observations on Marine Luminosity.

Dr. Hancock read a paper "On the Cow fish, *Manatus fluviatilis*, of the inland waters of Guiana."

Dr. Macartney made some observations on the preservation of animal and vegetable substances from the attacks of insects. He employed a concentrated solution of equal parts of alum, nitre, and salt, mixed with an equal quantity of proof spirits and a little oil of lavender or rosemary. A forcible injection of this liquid into the arterial system would perfectly preserve a dead body for three or four months fit for dissection, and portions of one which had been thus injected, if rubbed over with pyroligneous acid, might be preserved for any length of time. He recommended a coat of plaster of Paris to be daubed over succulent plants as a mode of preserving them, and, when dry, this might be easily removed. He noticed the entire preservation of some bodies found in the bogs of Ireland.

Mr. Hope exhibited a collection of North American insects, principally Coleoptera, collected from the raw turpentine sent over to

this country in which they had become entangled. They were extracted from the turpentine whilst it was slowly melting at the warehouse, and then placed in spirits of turpentine to cleanse them thoroughly. In this way they may be prepared in as great beauty and perfection as when newly captured.

Section E.—Anatomy and Medicine.

Dr. Macartney read the report of the Dublin Committee, appointed by the British Association, "On the Motion and Sounds of the Heart;" and the report of the London Committee, "On the Sounds of the Heart," was read by Dr. Clandining. Dr. Symonds then read a letter from Dr. Spittal, of Edinburgh, stating, that in consequence of the death of Prof. Turner, and the absence of one of the members on the continent, the committee had not been able to prepare a report. After that a paper was read "On the Gyration of the Heart," by F. A. Greeves, Esq.

The President then read a communication from Dr. Brewster, entitled, "A singular development of Polarizing Power on the Crystalline Lens, after death," and also a letter from the same, "On Cataract, or a disease resembling Cataract," which, if resisted in its earlier stages, the Doctor believed, from personal experience, might be overcome. For detecting this disease, which generally manifested itself between forty and sixty, the Doctor gave instructions, and further stated, that by attention to diet and regimen, and taking care not to study by night, he had been cured in about eight months. If the affection had not been checked in time, he entertained no doubt it would have ended in cataract.

Dr. Carson then communicated some "Observations on Absorption."

Section F.—Statistics.

A paper on Statistical Desiderata, by W. R. Greg, Esq., of Manchester, was presented by the Rev. E. G. Stanley.

Mr. John Taylor, Treasurer to the Association, read a paper on the comparative value of the mineral productions of Great Britain and the rest of Europe. A calculation, he said, was made by Mr. C. F. Schmidt, in 1829, of the value of the mineral productions of Europe, at continental prices; and, from the accuracy of the statements coming within Mr. Taylor's own knowledge, he was disposed to believe in the others. It should be borne in mind that the con-

tinental prices differed greatly from those in England, and, consequently, that the amounts were comparative, and not absolute value. The value of the mineral products of Europe, including Asiatic Russia, were,—gold and silver, 1,943,000; other metals, 28,515,000; salts, 7,640,000; combustibles, 18,050,000; making in round numbers a total of about fifty six millions, exclusive of manganese. Now to this amount Great Britain contributed considerably more than one half, viz. twenty nine millions, in the following proportions:—silver, 28,500; copper, 1,369,000; lead, 769,000; iron, 11,292,000; tin, 536,000; salts, 756,250; vitriol, 33,000; alum. 33,000; coal, 13,900,000. He then gave a sketch of the history of mining in Great Britain, dwelling strongly on its vast increase since the introduction of the steam engine.

Evening Meeting at the Theatre.—The Secretaries having read abridged reports of the proceedings of the Sections, a very interesting letter was read from Sir John Herschel to Sir William Hamilton.

Thursday, August 25.

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE.

Mr. Peacock read a communication from Mr. Talbot "On the Integral Calculus."

Dr. Apjohn made a communication "On the use of the Wet-bulb Thermometer, in determining the specific heat of air."

Prof. Sir. W. R. Hamilton then made a communication "On the Calculus of Principal Relations."

The Rev. Mr. Scoresby gave an account of two very delicate Magnetic Instruments.

Prof. Forbes read a paper "On Terrestrial Magnetic Intensity at great elevations from the earth." The author began by giving a rapid review of Saussure's observations connected with this subject. It was well known (he said) to men conversant with these researches, that this enterprising philosopher and naturalist ascended Mont Blanc, nearly at the summit of which he resided for many days, making and recording numerous meteorological experiments, at an elevation of about eleven thousand feet above the level of the sea; but when his observations upon the magnetic needle were properly corrected, for the depression of temperature well known to exist at these great elevations, the result of them was, that at this great elevation there was no alteration of magnetic intensity which could be

safely pronounced to be beyond the limits of the errors of observation. Subsequently, Gay-Lussac ascended in a balloon to the altitude of about, or perhaps beyond twenty three thousand feet, yet his observations also, when due allowance was made for alteration of temperature, gave no alteration of the magnetic intensity. But the researches of M. Kuppfer seeming to conduct to a quite opposite conclusion, and the result, as stated by him, being such as, if the observations were correctly made, would give a diminution of the magnetic intensity for stations whose elevation above the earth was considerable, which could by no means be accounted for by ordinary errors of observation, Prof. Forbes deemed this a matter of so much importance to science, that he determined to make an extended series of observations at various levels among the Pyrenees and Swiss Alps. Accordingly, having last summer provided himself with a sufficient number of magnetic needles fit for making proper observations upon magnetic intensity, and their times of vibration at Paris having been accurately ascertained, he commenced his tour for this purpose in the neighborhood of Barège and Bagnières; and, from a multitude of observations which he had made and recorded, he now wished to select a series of forty five observations made at thirteen different stations, the elevation of which above the level of the sea varied from six thousand to ten thousand feet. Before he detailed these observations and their results, he described the principle upon which they were conducted, and which appeared ingenious, and well calculated to lead to satisfactory results. In each instance, the observations were made at three distinct stations—one on the summit of the mountain peak, or most elevated spot; and two at a lower, but equal level on each side of the hill, so chosen, that a vertical plane would pass through the three stations, and be perpendicular to the axis or length of the hill. It is obvious then, that, speaking generally, any disturbing effect exercised upon the needle by the materials of the hill at one of the lower stations, would be opposite in kind to that exercised at the other of the two lower stations; and, therefore, the mean between these observations, made at the two lower stations, would give the magnetic intensity at a point immediately beneath the upper station. By a comparison of this mean intensity, therefore, with the intensity at the upper station, it could be readily proved whether or not the intensity diminished as you ascended to a greater elevation. The result of the entire of this laborious course of experiments was, that, with the

exception of one solitary instance, the station being in the Pyrenees and in the neighborhood of iron mines, there was no diminution of the magnetic intensity at the higher stations, at least beyond the limits of the necessary errors of instruments and observations: even at the station where some diminution did manifest itself, the quantity of that diminution was very much smaller than that which resulted from the views of M. Kuppfer.

Prof. Powell read a paper "respecting the impermeability of water to radiant heat."

A paper by Sir David Brewster, "On the action of crystallized substances upon Light," was then read by the Secretary, Mr. Snow Harris.

Dr. Williams gave an account of an improved ear trumpet.

The President then said, that as there were yet a great many interesting communications to be brought forward, the Section would reassemble at eight o'clock in the evening.

Thursday Evening.—Mr. G. W. Hall made a communication upon "the connexion observed at Bristol between the weather and the tide." He commenced by stating, that long and carefully continued observation of the weather at Bristol, together with a direct interest in becoming possessed of rules for anticipating its changes, led to the following theory, which was strikingly correspondent with facts. First, that the barometer very generally, indeed, almost invariably, undulates at times corresponding with the changes of the moon, and at these times it more frequently falls than rises. Secondly, that the weather is ordinarily unsettled at these periods, continuing so for about two or three days; and for the most part the wind becomes high at these times. Thirdly, that as the weather settles (if it become at all settled, since it not unfrequently remains in an unsettled state,) so will it continue until the next change of moon, or rather until the recurrence of its disturbing influences. Fourthly, that these variations occur as regularly at the quarters of the moon as at the new and full, and are then as fully marked. Fifthly, that the period, about five days, which determines the state of the weather, is derived from the spring and neap tides, or the full influence of the sun and moon upon them.—The only origin of these rules, he stated, was actual observation. Very striking changes of temperature and weather, from intense frost to spring mildness, and then frost recurring, first led to marking this correspondence; and so closely has it been observed, and so fully established, that opera-

tions upon a large scale, which are dependent upon the weather, have been frequently and successfully conducted in accordance with these rules. He considered the severe frost of 1813–14, which continued about twelve weeks, with partial thaws intervening, and the severe weather of succeeding winters, with their intermissions, to be closely connected with the above rules. The partial rains also of very dry summers have been found to take place at the same seasons of change, insomuch that for amusement he had frequently traced back the periods connected with the age of the moon, from the thaws that took place in severe weather, or the rains occurring in long continued drought. Residing on the banks of the river, and taking much interest in the operations of Professor Whewell respecting the tides, and his description of these, Mr. Hall stated that he had been led closely to compare them with the weather; but difficulties to him insurmountable had occurred, when considering the variations of weather in different places at the same time; yet, regarding those in the neighborhood of Bristol, his conviction was unwavering. Perhaps the varying time at which the tide reaches various places, so fully described by Professor Whewell in his lecture on Tuesday evening, might assist in solving this difficulty; and if the attention of others were directed towards it, his end would be attained.

Mr. Ettricke then gave a description of "an instrument intended to observe minute changes of Terrestrial Magnetism," and of other philosophical instruments.

Mr. R. Addams then made a communication respecting the vibration of bells.

Mr. Rootsey then read papers "on the Music of the Greeks, and a system of Mnemonic Logarithms."

Section B.—Chemistry and Mineralogy.

Dr. Daubeny stated, that he had ascertained that the sublimation of carbonate of magnesia was entirely a mechanical process, and he inferred that no support could hence be given to Von Buch's well known theory of dolomization.

Dr. Dalton then gave an exposition of his views upon the subject of chemical notation, and the atomic constitution of chemical substances.

Mr. Johnston explained the use of some chemical tables which he exhibited.

Dr. Thomson read a very valuable paper on mixtures of sulphuric acid and water, in which he shewed that the theory of Irvine respecting specific heat cannot be true.

Mr. Jones detailed the results of an elaborate analysis of wheat, and mentioned that he had formed a new and peculiar volatile fluid by the action of sulphuric acid on wheat.

Section C.—Geology and Geography.

A paper was read by the Marquis Spineto on the geographical position of Memphis, in Egypt. The state of that city during the time of its long prosperity was first considered; then the causes of its destruction; and lastly, the opinions of different travellers regarding its position. Its particular site had been described by ancient historians as on an island in the Nile, evidently formed of the mud of that river; and that it had been protected from inundations by various extensive works erected by its kings. When its splendor decayed, these works went out of repair, and hastened the ruin of the city, which strewed with its fragments the place on which it had stood. Finally, it was submerged under drifted sand, and its true position became a problem to modern travellers. Of late, however, the site has been determined by the French, who, in one of their exploring expeditions, had examined the stratification of the place supposed to be Memphis, and they ascertained the spot by the succession of drifted sand, ruins, and mud. Its latitude they fixed at 29° 20′ N. and longitude at 31° 30′ E. from Greenwich.—Mr. Murchison spoke of the great value of geographical papers to the geologist, and of the one just read, as an excellent example of this kind.—Dr. Buckland took this opportunity of mentioning the establishment of M. Van der Maelen, at Brussels. That gentleman had devoted, in the most praiseworthy manner, his time and fortune to the advancement of science, by making large geographical and geological collections, for the purpose of diffusion over the world, by means of exchange with societies or individuals. Dr. Buckland advocated such a mode of obtaining maps and specimens to the different provincial societies of the United Kingdom.

The next paper was on the change in the chemical character of minerals induced by galvanism. Mr. Fox mentioned the fact, long known to miners, of metalliferous veins intersecting different rocks, containing ore in some of these rocks, and being nearly barren or entirely so in others. This circumstance suggested the idea of some

definite cause; and his experiments on the electro-magnetic condition of metalliferous veins, and also on the electric conditions of various ores to each other, seem to have supplied an answer, inasmuch as it was thus proved that electro-magnetism was in a state of great activity under the earth's surface, and that it was independent of mere local action between the plates of copper and the ore with which they were in contact, by the occasional substitution of plates of zinc for those of copper, producing no change in the direction of the Voltaic currents. He also referred to other experiments, in which two different varieties of copper ore, with water taken from the same mine, as the only exciting fluid, produced considerable Voltaic action. The various kinds of saline matter which he had detected in water taken from different mines, and also taken from parts of the same mine, seemed to indicate another probable source of electricity; for can it *now* be doubted, that rocks impregnated with or holding in their minute fissures different kinds of mineral waters, must be in different electrical conditions or relations to each other? A general conclusion is, that in these fissures metalliferous deposits will be determined according to their relative electrical conditions; and that the direction of those deposits must have been influenced by the direction of the magnetic meridian. Thus we find the metallic deposits in most parts of the world having a general tendency to an E. and W. or N. E. and S. W. bearing. Mr. Fox added, that it was a curious fact, that on submitting the muriate of tin in solution to voltaic action, to the negative pole of the battery, and another to the positive, a portion of the tin was determined like the copper, the former in a metallic state, and the latter in that of an oxide, shewing a remarkable analogy to the relative position of tin and copper ore with respect to each other, as they are found in mineral veins.

Artificial Crystals and Minerals.—A. Crosse, Esq. of Broomfield, Somerset, then came forward, and stated, that he came to Bristol to be a listener only, and with no idea he should be called upon to address a section. He was no geologist, and but little of a mineralogist; he had however devoted much of his time to electricity, and he had latterly been occupied in improvements in the voltaic power, by which he had succeeded in keeping it in full force for twelve months by water alone, rejecting acids entirely. Mr. C. then proceeded to state, that having observed in a cavern in the Quantock Hills near his residence, that part of it which consisted of

slate was studded with crystals of *arragonite,* while the limestone part was covered with crystals of *calcareous spar,* he subjected portions of each of these substances in water, to long continued galvanic action (ten days action,) and obtained from the slate crystals of arragonite, from the limestone crystals of calcareous spar. In order to ascertain if light had any influence in the process, he tried it again in a dark cellar, and produced similar crystals in six days, with one fourth of the whole voltaic power. He had repeated the experiments a hundred times, and always with the same results. He was fully convinced that it was possible to make even diamonds, and that at no distant period every kind of mineral would be formed by the ingenuity of man. By variations of his experiments he had obtained crystallized quartz, the blue and green carbonates of copper, chrysocolla, phosphate of copper, arseniate of copper, acicular carbonate of lead, sulphate of lead, sulphuret of iron, white antimony, and many other minerals.

Prof. Phillips then gave an interesting description of a bed of magnesian limestone, which exists near Manchester.

Evening Meeting.—Mr. Murchison exhibited a map of England, colored to represent some phenomena of physical geography, and for the purpose of answering a question proposed by the Association. On a former evening Mr. Phillips had given an account of the boulder stones found in the north of England, and which had been traced even as far as Worcestershire. Mr. Murchison, in his researches in Wales and the neighboring counties, had not observed these carried to the country bounded by the Severn, nor had he observed any of the Silurian gravel carried to the central parts of England. From this he concluded that Siluria must have been formed subsequently to this central part, which might have been an island or part of the continent. In this country of Siluria he had found the deposits of gravel perfectly local; nor could he perceive in this gravel any recent shells; on the borders of the South Wales Coal Basin were marks of diluvial action—fragments of coal strata being thrown off as from a centre. Another proof of the newer elevation of this part of Britain, are the marks of large lacustrine expanses at recent periods. Out of this tract not only do we observe the boulders of granite extending from north to south, but we find fragments of recent marine shells in the diluvium of Lancashire, Cheshire, Salop, and part of Stafford, all diminishing as we approach the Severn. But he was of opinion that these boulders could not have been so diffused

when the surface had been dry land, but that the operation must have been effected under the sea, as proved by the presence of these marine shells, and by the fact of boulders having been found on the summits of the sides of valleys, which could not have been brought to those positions save by the agency of currents of the ocean. This later period of the elevation of Siluria, must have produced also the present course of the Severn. In concluding his remarks, Mr. Murchison mentioned the possibility of icebergs assisting in the transport of diluvium.—Mr. Conybeare mentioned the fact of chalk boulders being found upon Flat Holm, near Bristol, which stones must have been brought down by the Avon.

Section D.—Zoology and Botany.

Dr. Moore announced his having procured a fish in Plymouth Harbor, new to Great Britain, the *Trigla cataphractes*, and Mr. Yarrell confirmed the accuracy of the observation, and stated the species to be common in the Mediterranean.

Dr. Richardson then read the concluding portions of his report. The order Edentata is eminently South American, and only three or four species are met with in North America. The fossil species of Megatherium and Megalonyx, however, are found in both Americas.—The order Pachydermata is remarkable for the size of most of its species, and the number of the extinct species is more than double the recent ones in the New World. Only two genera and three or four species belong both to North and South America. Fossil elephants and mastodons occur in the most distant parts of North America. Although the present race of horses is certainly of European origin, yet fossil bones of this quadruped are met with in Kotzebue's Sound.—Thirteen species of Ruminantia were enumerated, two of which are common to the old and new continents, and have a high northerly range. The North American deer are very imperfectly known. The reindeer reach to Spitzbergen and the most northerly of the American islands, and range southwards as far as Columbia River on the Pacific coast, and to New Brunswick on the Atlantic. Although the musk-ox ranges from the barren lands over the ice to Parry's Islands, it is not found either in Asia or Greenland.—There appears to be nine species of Cetacea, known as North American, and those on the east coast are mostly inhabitants of Europe also, under the same parallels of latitude, especially those of the Greenland seas. On the western side the

species are common to Asia also.—The report then proceeded with an account of the Ornithology, which Dr. Richardson said it would be unnecessary to touch upon at so great length or with so much detail as the Mammalia, since the species were so much better known, a great majority of them being migratory, and therefore those which lived in the less frequented regions were, at stated seasons, visitants of the more civilized districts. Local lists, however, were still wanting to enable naturalists to trace their geographical limits with precision, and, more especially, our knowledge was very imperfect of those of California and Russian America. Of about five hundred species, there were one fourth to be found in Europe, but not more than one eighth in South America. Of the former, or those common to North America and Europe, thirty nine were land birds, twenty eight waders, and sixty two water birds. Several of the generic forms were peculiar, but only two of the families, viz. the Trochilidæ and Psittacidæ, were not to be found in Europe; and the Hoopoe is the only European representative of the whole order to which the former of these families belongs. No vultures are common to both worlds, but nearly half the other birds of prey are so, and many of these range over South America also, and indeed the whole world. One fourth of the Corvidæ are inhabitants of Europe; but the other land birds, common to both continents, are in much smaller proportions, and not more than two out of sixty two Sylviadæ are European. The number of species common to North and South America is very uncertain. Some of the most numerous families characteristic of the former country have few or no species in South America. It is remarkable that only one Trochilus has been described as common to North and South America, although this family is peculiarly characteristic of the latter country; and there are twenty two species which have been described as natives of Mexico. Dr. Richardson then detailed several particulars respecting the migration of birds, stating it to be his opinion, that the spring movement was for the purpose of finding a convenient place for incubation and rearing the young. The lines of route were influenced by the supply of food to be obtained, and thus the northerly and southerly courses were often over different tracts; and he pointed out the three great lines of route which were to a certain extent determined by the physical features of the country. The absolute number of birds to be found in different countries decreases on receding from the equator towards the north pole; but of those which

stay to breed in any place, the number increases from the equator up to the 60th degree of north latitude, where the forests begin to grow thin. But the progress of civilization has already had an influence on the migrations of certain species, by affording them an abundant supply of provisions, where they were before without any. Thus the starlings proceed further north as the culture of the Cerealia continues to extend in that direction, and the introduction of certain tubular flowers into the gardens of Florida, has enticed species of humming birds thither from the south. Some details were then given of the distribution of the various families of birds, and a table in the report exhibited the absolute number of species, as well as the number of such as breed in Philadelphia, Massachusetts, and Suskatchewan.

Mr. Phelps read a communication "on the formation of Peat."

Mr. Mackay then read a communication he had received from Mr. Nuttall, "on the management of the Pine tribe."

Dr. Lloyd read a communication on the Marsileaceæ.

An abstract of a paper from Mr. P. Teale was read, "on *Alcyonella stagnorum*;" and very beautiful preparations and specimens of it were placed on the table. It was found in great abundance from August to November, in 1835, in a small pond near Leeds. It was supposed to be new to Great Britain.

Dr. Riley mentioned a circumstance in the osteology of the two toed ostrich, which had escaped observation. He showed, that the third toe was really present in a rudimentary state concealed by the integuments. It consists of two phalanges, and is articulated with a well defined condyle of the tarsal bone, and projects on the same plane with the other two.

Section E.—Anatomy and Medicine.

Dr. Hodgkin read a paper on the connexion between the veins and absorbents.

Dr. Reid of Dublin then read to the section a paper, entitled, "a short exposition of the functions of the nervous system."

Section F.—Statistics.

Prof. Forbes described the result of his application of Quetelet's principle, of describing the increase of stature, weight, and strength by curves. He had carefully experimented on English and Scotch students, between the ages of fourteen and twenty five, in the Uni-

versity of Edinburgh. The general laws of the curves were nearly those established by Quetelet. In the comparison of nations, the Irish appeared to be the first in all physical developments, the Scotch ranked next, the English were the lowest of the three nations, but they were above the Belgian. It was generally remarked, that the data for the Irish and English were not sufficiently accurate to justify any general conclusions.

A paper from Dr. Collins on periodicity of birth was read.

Baron Dupin exhibited two maps of Britain, colored on Guerry's plan, to illustrate criminal statistics, and their relation to density of population and education. The latter was both the more prominent, and, in relation to subsequent discussion, the more important branch of the Baron's observations. He drew a distinction between moral and physical education, describing the latter as an indifferent instrument, capable of being applied either to good or evil. He then briefly glanced at the proportion between juvenile offenders in England and France, stating as a general result, that the young criminals of England more frequently reformed than those of the Continent.

Friday, August 26.

Section A.—Mathematical and Physical Science.

Mr. Whewell read a paper on a new Anemometer. In this communication Mr. W. explained a method of tracing or registering the course of the winds through a given period by the motion of a pencil, on an appropriate scale, so as to obtain eventually a true type of the winds, which has never yet been arrived at by other instruments.

Prof. Phillips read a notice of the probable effects of elevated ground in the direction of the lines of equal magnetic dip.

Prof. Stevelly read a paper on the mathematical rules for constructing compensating pendulums.

Telescopes.—Sir D. Brewster read a paper describing a contrivance by which he was enabled to render distinct the dark lines of the spectrum under the most unfavorable circumstances, and obtain other useful effects. The method was to introduce a cylindrical refractor between the eye and the eye-glass of the telescope, the effect being, as he shewed, to give a linear form to a most irregular image.

Mr. Russell read a paper on certain elements of the resistance of fluids that appear to be intimately connected with the application of analysis.

Dr. Hare read a communication relating to the prevailing theories of electricity; he endeavored to explain many interesting phenomena attendant on the electric spark and the divergence of electrified bodies.

Dr. Carpenter described a system of teaching the blind to read, similar to Mr. Lucas's.

Mr. Hodgkinson read an account of some experiments, at the request of the Association, to determine the comparative strength and other properties of iron, made with the hot and cold blast, at the Carron, Devon, and Buffrey works, under similar circumstances.—In the Carron and Buffrey works, the strength was rather in favor of the cold blast. In the Devon iron the advantage was much in favor of the hot blast; but it is proper to remark, that the cold blast iron was very white in the break, and that from the hot was grey.

Section B.—Chemistry and Mineralogy.

The following papers were read: Some improvements on the Voltaic Battery. By Mr. Crosse.—Observations on Atmospheric Electricity. By Mr. Crosse.—On a new compound found during the destructive distillation of wood. By Mr. Scanlaw.—On a peculiar compound of Carbon and Potassium. By Prof. E. Davey.—On a new gaseous Bicarburet of Hydrogen. By Prof. E. Davey.—On the conducting power of Iodine. By Dr. Inglis.—On Fluorine. By Mr. Knox.—On detecting the Strength of Spirits, by diluting with water. By Mr. Black.—Communication on the Aurora Borealis. By Dr. Traill.

Section C.—Geology and Geography.

Sea Rivulets in the Island of Cephalonia.—Lord Nugent read a communication respecting some sea rivulets in the island of Cephalonia. The water, he said, entered the earth through fissures in the rock, on the sea shore, and it was not discovered where it emerged, but it was supposed to flow into the sea, on the side of the island nearest Ithaca. Some observations were made by the Marquis of Northampton, Mr. Murchison, Dr. Daubeny, and the Chairman, but no solution of the problem was given.

Tertiary Deposits.—Mr. Charlesworth read an elaborate paper on some fallacies in Mr. Lyell's test in determining the ages of tertiary deposits by the per centage of existing species, which may be considered as a continuation of his paper on crag formations.

Prof. Forbes made a communication on the connection of the Pyrenian hot springs with the geology of the district, in which he gave an outline of the physical structure of the Pyrenees.

The Rev. Mr. Clarke stated the existence of two hot springs at Longfleet, near Poole, maintaining their temperature of fifty four degrees in all seasons of the year.

A communication by Prof. Traill of Edinburgh was read, giving an account of various localities of fossil fishes in Pomona, Orkney. A map and specimens were exhibited, and observations made by Dr. Buckland, Mr. Greenough, and others. A drawing of a remarkable fossil fish from Clashbinnie, Forfarshire, was laid before the section by John Robinson, Esq. of Edinburgh.

Section E.—Anatomy and Medicine.

The first paper read was entitled "Observations on the Pathological Condition of the Bones in Chronic Rheumatism;" and "On the Condition of the new Circulating Channels in a case of Double Popliteal Aneurism. By Mr. Adams."

The third paper read was a report on "Fracture of the Neck of the Thigh Bone. By Dr. Evanson."

Mr. Hetling read a paper "On a new Instrument for the Removal of the Ligatures of Arteries" at pleasure.

The last paper read was on the Chemistry of the Digestive Organs, by Mr. R. T. Thompson.

Mr. Gordon, dentist, of Park Street, exhibited (although in an unfinished state,) some beautiful models, in ivory, representing the head, neck, heart, and lungs of the human body.

At the meeting of the General Committee, held on Saturday, August 27, it was determined that the Meeting of the Association for 1837 should be held at Liverpool, in the month of September. The following are the Officers appointed: The Earl of Burlington, *President;* Dr. Dalton, Sir Philip Egerton, Rev. E. G. Stanley, *Vice Presidents;* Dr. Charles Henry, Mr. Parker, *Secretaries.*

Art. XXII.—*Description of a new species of fresh water Tortoise, inhabiting the Columbia River;* by Richard Harlan, M. D., F. L. S., &c.

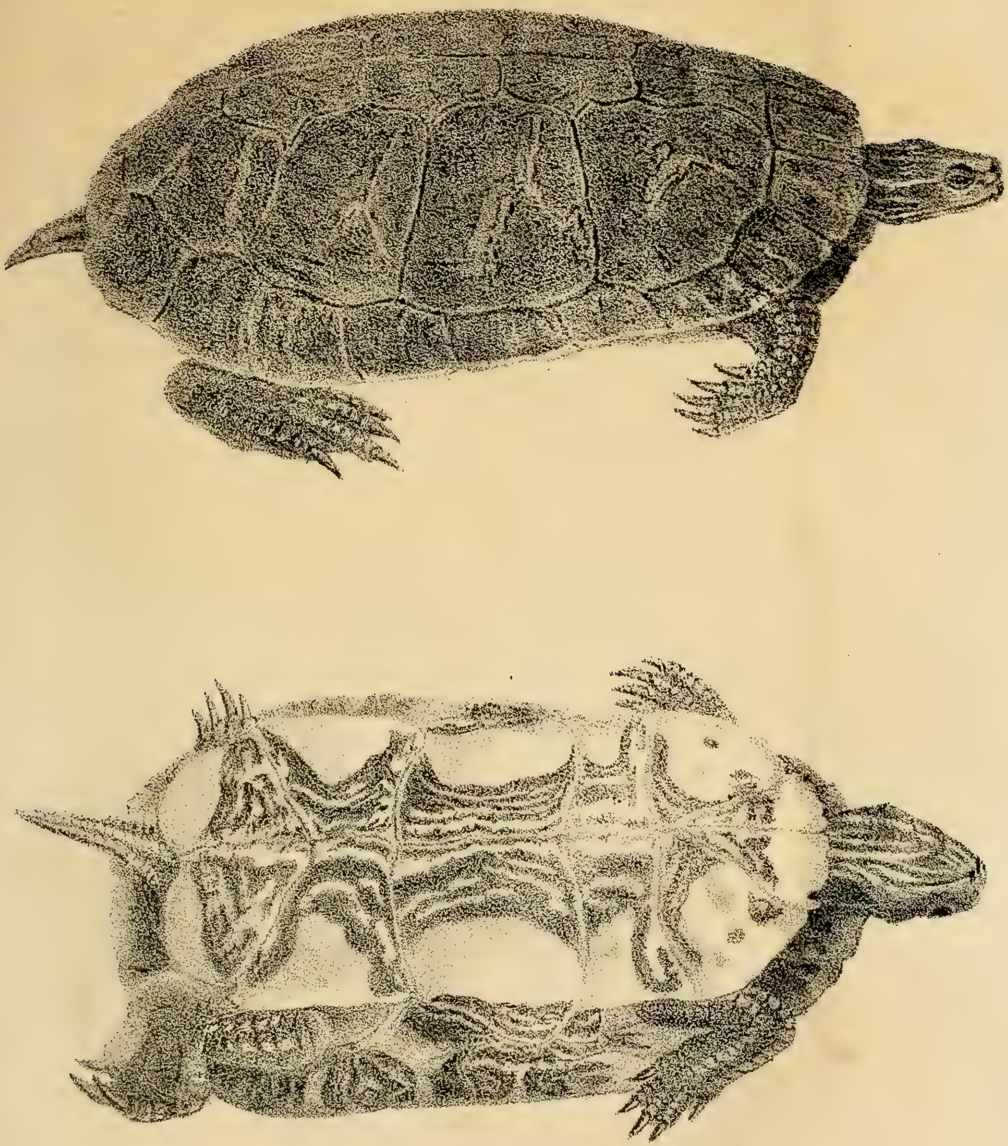
Emys *Oregoniensis*—(see plate.)

Characters.—Shell suboval, moderately depressed; dark brown or olive, with bright yellow irregularly disposed lines with black borders; anterior marginal plates very deep: sternum oblong, slightly constricted in the middle, emarginate and bidentate anteriorly, bright yellow, beautifully and curiously figured with black, with yellow curved longitudinal lines; head of moderate size, upper jaw bidentate at tip.

Description.—Shell broadest posteriorly, about the usual height of animals of this genus, rather depressed, very slightly emarginate behind, more so anteriorly, there being a deep notch on either side of the single anterior marginal plate, which is nearly pointed anteriorly; the vertebral plates five in number, the first nearly square, the second, third and fourth irregularly hexagonal, the posterior border of the latter curved so as to admit the arched anterior border of the fifth plate to project into it—the fifth plate elliptical above, and presenting four faces at its lower border for articulation with as many border plates: first lateral plate nearly triangular, connected with the first five marginal plates, the two middle lateral plates form oblong squares, with each an acute angle above entering between the sutures of the vertebral plates,—the last or fourth plate is pentagonal.

Marginal plates twenty five in number,—the nuchal plate pyramidal in form, with a deep notch on either side of its apex, its posterior margin being marked with two transverse depressed lines, the two first marginal plates on either side of the single one are quadrilateral and bluntly serrate on the anterior margin, and together with the third plate are unusually deep—the three following plates become abruptly narrowed and slightly emarginate at the inferior border—the six posterior plates are again enlarged, nearly square, and the two latter plates with each a slight notch on their inferior borders.

Sternum, yellow tinged with red on its outer sides, the central portions being figured with irregularly curved black bands interspersed with interrupted yellow lines; the second plates with each a black dot in their centre: the two anterior plates triangular, with their



EMYS ORIGONIENSIS

bases anterior, forming the outer border, which projects slightly beyond the general border, and is bluntly serrated in the middle, and with a dental process at the basal angles:—of the twelve plates composing the sternum, all are of different shape and size, the central longitudinal suture irregularly curved.

Head of moderate size, rather depressed; the upper jaw armed at its apex with two strong dental processes:—color of the crown of the same dark olive, mottled with black and yellow, as the rest of the animal—throat and neck with bright yellow longitudinal lines, which extend on the fore feet:—the inferior surfaces of the marginal plates marked with black bands striped with yellow.

Tail of the ordinary dimensions of animals of this genus;—the same may be observed respecting the feet; the anterior nails are longer than the hind nails; in both, the middle nails are the longest.

Dimensions.—Length of the back plate 8 inches; breadth of the same 6 in.: length of the sternum 7 in.; breadth of the same 4 in.: depth of the animal 2 in. 2 tenths: length of the head 2½ in.; breadth of the same 1 in. 1 tenth: length of the longest claw 6 tenths; length of the longest posterior claw 4 tenths.

General Remarks.—My friend Thomas Nuttall, whose indefatigable exertions in natural history have extended throughout North America, on his recent travels across the continent to the Pacific Ocean, obtained the present specimen in the fresh water ponds in the vicinity of the Oregon or Columbia River, where this species was observed to abound, to the exclusion, according to his observation, of any other tortoise.

Art. XXIII.—*Notice of the* Orbicular Lizards, *or horned Agamas;* by R. Harlan, M. D., &c.

Among the valuable treasures in natural history, recently brought by Mr. Nuttall from his journey across the Rocky Mountains to the Pacific Ocean, are several excellently preserved specimens of a large species of Orbicular lizard, which he kindly placed at my disposal for the purpose of description. Mr. Nuttall obtained his specimens in California, and preserved them living for many weeks: he considered them of a very docile nature, never attempting to use their horns in self-defence; they inhabit under stones, and in holes, in the

more barren parts of the country. Hitherto great confusion has existed among authors relative to the animals classed under this name. The Orbicular lizard of Linnæus and Agama orbicularis of Daudan and Tapayaxin of Seba, belong to an entirely different genus, the Trapelus, which inhabits Africa: these facts were first announced in a memoir which I published in the year 1824, vid. Journ. A. N. S. Philad. Vol. iv. pl. xx,—on the Agama cornuta, of Missouri and Arkansas, and other portions of the United States territories. A very critical essay on these Orbicular lizards was published by Gravenhorst in 1833, vid. Acta Acad. Caes. Leop. Carol. Nat. Cur. Vol. xvi. p. ii.; in which the learned author has fallen into some errors. Together with Cuvier and Wagler, he confounds the Tapayaxin of Hernandez with the Agama cornuta of Harlan, whereas these form two very distinct species: he further errs in attributing to Weigman the priority in contributing any definite information relative to this animal, as is shown by the following extract from the memoir above quoted: "Weigman of Berlin was the first, as far as I know, who gave any definite information concerning this animal, and who showed at the same time that it differed from the others with which it had been compared, not only in the species, but also in the genus." p. 912. None of the naturalists above quoted appear to have had an opportunity of comparing our Agama cornuta with the Phrynosoma orbicularis of Weigmann, otherwise they could scarcely have overlooked the prominent characters which distinguished these two species: there can be no doubt, on accurate comparison, that the last named animal is the true Tapayaxin described and figured by Hernandez; and which differs in size, markings and proportional development of the tail, from the Agama cornuta. We have received numerous specimens of the Agama cornuta from Mexico, as well as from the United States and territories, the largest of which are little more than one half the size of the Tapayaxin; the horns of the head also differ in their proportional size, and somewhat in their arrangement; the large transverse black bands on the back are peculiar to the Phrynosoma or Agama orbicularis: whilst in the A. cornuta there is also a constriction at the base of the tail, which is absent in the former,—the most accurate figure of the A. orbicularis is given by Gravenhorst. The occipital spines in these animals partake of the nature of true horns, consisting of an osseous core with a sheath of horn, which becomes easily detached in maceration.

The following are the comparative dimensions of one of the largest specimens of both species.*

Agama Cornuta.		Tapayaxin.	
Total length,	3 in. 6 eighths.	Total length,	6 in.
Length of tail,	1 in. 2 eighths.	Length of tail,	2 in.
Breadth of body,	$1\frac{1}{2}$ in.	Breadth, varying.	
		Length of longest horn,	$\frac{1}{2}$ in.

The following are the ascertained synonymes of the animal of Hernandez, viz.

Tapayaxin Lacertus orbicularis, Hernandez, Nova Plant. Anim. Min, Mexicanorem Hist. p. 327, 328—(see plate.)

Phrynosoma orbicularis, Weigmann, in Isis, 1828, pp. 365–368. Wagler, Icon. Amph. pl. 23. fig. 1. and Nat. Hist. of Amph. p. 146. Gravenhorst, Acta. Acad. Cæs. Leop. Carol. Nat. Cur. vol. xvi. p. ii.

Tapaya orbicularis, Cuv. Régne animal. ii. p. 37.

Agama orbicularis, Voigt, Trans. of Cuv. R. A. ii. p. 59.

We have seen a specimen of A. orbicularis in the museum of Cincinnati, said to have been obtained from the plains of Missouri. If the statement be correct, we shall have four species of Agama in the United States, viz.: A. Cornuta, A. Collaris, A. Douglassii; together with the first named species—vid. Harl. Med. and Phys. Researches, for figures of the others.

Art. XXIV.—*Description of a new species of Quadruped, of the order Rodentia, inhabiting the United States;* by R. Harlan, M. D.

Mus *palustris.*

Characters.—Body rather elongated, color above of a ferruginous brown; beneath, grayish white, the hairs being plumbeous at base: legs small: tail long: ears half the length of the head.

Description.—The color above resembling nearly that of the common Norway rat; beneath, grayish white; ears of moderate size, anterior borders slightly inverted, sparsely hairy within and without:

* The specimen figured by Wagler, was rather larger, viz. total length 7 in.; tail $2\frac{1}{2}$ in.

legs very small and slender: toes five in number on all the feet, terminated by small hooked nails, with the exception of the four thumbs, which are armed with a small and broad nail: tail about the length of the body, not including the head and neck, covered with short hairs, and terminating in a delicate pencil. Head rather elongated; snout furnished with from twenty to thirty setæ of different lengths, some white, others black: teeth, consisting of six molars in each jaw, invested with enamel, and marked on their crowns with transverse eminences: four incisors, short above, and sub-piceous on their anterior surfaces; inferior, long, compressed, and white.

Dimensions.—Total length about nine inches, viz. of the head 2 in. 2 tenths, of the body 4 in., of the tail 4 in.: length of the anterior extremities rather more than 1 in.

Habitat.—Found in the fresh water swamps of New Jersey and South Carolina. The present specimen was taken near "Fast land," in the vicinity of Salem. A similar specimen was sent to me by Dr. Bachman, of Charleston, S. C.—Cab. of A. N. S. Philad.

Remarks.—Native species of true rats are very rare in the United States; besides the present perhaps but one other species exists in this country,—unless indeed we admit the Mus rattus to be native. The Mus *Sylvaticus* is common to Europe and North America; the Mus leucopus, and Mus nigricans of Raffin. we take, from his descriptions, to be mere synonymes.

MISCELLANIES.

DOMESTIC AND FOREIGN.

1. *On the Meteoric Shower of November*, 1836. By Denison Olmsted, Professor of Natural Philosophy and Astronomy in Yale College.

For six years in succession, there has been observed, on or about the 13th of November of each year, a remarkable exhibition of *shooting stars*, which has received the name of the "Meteoric Shower."

In 1831, the phenomenon was observed in the State of Ohio,* and in the Mediterranean, off the coast of Spain.† In 1832, the

* Amer. Journal of Science, xxviii, 419.

† Bibliotheque Universelle, Sept. 1835.

shower appeared in a more imposing form, and was seen at Mocha, in Arabia;* in the middle of the Atlantic Ocean;† near Orenburg, in Russia;‡ and at Pernambuco, in South America.§ The magnificent Meteoric Shower of 1833, is too well known to require the recital of any particulars. Of the recurrence of the phenomenon at the corresponding period in 1834, and in 1835, evidence has been presented to the public in previous numbers of this Journal. (See Vols. xxvii, pp. 339 and 417. xxix, 168.)

I now feel authorized to assert, that *the Meteoric Shower reappeared on the morning of the 13th November*, 1836.

It has been supposed by some, that the appearance of an extraordinary number of shooting stars, at the several anniversaries since the great phenomenon of November, 1833, can be accounted for by the fact, that so general an expectation of such an event has been excited, and that so many persons have been on the watch for it. Having, however, been much in the habit of observing phenomena of this kind, I can truly say, that those exhibitions of shooting stars which have for several years occurred on the 13th or 14th of November, are characterized by several peculiarities which clearly distinguish them from ordinary shooting stars. Such peculiarities are the following.

1. The *number of meteors*, though exceedingly variable, is much greater than usual, especially of the larger and brighter kinds.

2. An uncommonly large proportion leave *luminous trains.*

3. The meteors, with few exceptions, all appear *to proceed from a common center*, the position of which has been uniformly in nearly the same point in the heavens, viz. in some part of the constellation Leo.

4. The principal exhibition has at all times, and at all places, occurred between midnight and sunrise, and *the maximum from three to four o'clock.*

In all these particulars, the Meteoric Showers of 1834, 5, and 6, have resembled that of 1833; while no person, so far as I have heard, has observed the same combination of circumstances on any other occasion within the same period. I have not supposed it necessary, in order to establish the identity of these later meteoric

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* Amer. Jour. xxvi, 136. † Ib. 349.

‡ Ed. New Phil. Jour. *July*, 1836.

§ New York American, Nov. 15, 1836.

showers with that of 1833, that they should be of the same magnitude with that. A small eclipse I have considered a phenomenon of the same kind with a large one; and, conformably to this analogy, I have regarded an eclipse of the sun, first exhibiting itself as a slight indentation of the solar limb, but increasing in magnitude at every recurrence, until it becomes total, and afterwards, at each return, but partially covering the solar disk, until the moon passes quite clear of the sun,—as affording no bad illustration of what probably takes place in regard to these meteoric showers. The fact that the Aurora Borealis appears unusually frequent and magnificent for a few successive years, and then for a long time is scarcely seen at all, was proved by Mairan, a hundred years ago.* There is much reason to suspect a like periodical character in the phenomenon in question, which first arrested attention in 1831, became more remarkable in 1832, arrived at its maximum in 1833, and has since grown less and less at each annual return. Some seem to suppose that we are now warranted in expecting a similar exhibition of meteors on the morning of every future anniversary; but this, I think, is not to be expected. It is perhaps more probable, that its recurrence, unless in a very diminished degree, will scarcely be witnessed again by the present generation. The shower, however, at its late return, was more striking than I had anticipated; and it must be acknowledged to be adventurous, to enter the region of prediction respecting the future exhibitions of a phenomenon, both whose origin and whose laws we so imperfectly understand.

But it is time to present the reader with the evidence of the return of the meteoric shower on the late anniversary.

Accounts of observations before us show, that the meteoric shower was seen in most of the Atlantic States from Maine to South Carolina. We will begin on the north.

I. Observations made at Springvale, Maine. *Extract of a letter from Samuel Dunster, Esq., Agent of the Franklin Manufacturing Company.*

"I requested the watchman at our manufacturing establishment to call me, if any thing of interest occurred. He accordingly called me at about a quarter before three o'clock, [on the morning of Nov. 13th.] At three o'clock I began to count the meteors, and numbered as follows.

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* Traité Phys. et Hist. de L'Aurore Boréale. Par M. De Mairan.—Memoirs of the Royal Academy of Sciences for 1731.

Time.	Number.
3 h. 30 m. - - - - -	37
3 h. 45 m. - - - - -	25
4 h. - - - - -	31
4 h. 15 m. - - - - -	25
4 h. 30 m. - - - - -	22
4 h. 45 m. - - - - -	28
5 h. - - - - -	22
5 h. 15 m. - - - - -	16
5 h. 30 m. - - - - -	20
5 h. 45 m. - - - - -	11
6 h. - - - - -	11
6 h. 15 m. - - - - -	5
	253

"The meteors, with the exception of five or six, all had a direction from a point in the eastern part of the heavens about 15 degrees N. N. E. of the planet Jupiter; and, although they appeared in all parts of the sky, still, if the lines of motion had been continued backwards, they would all have terminated in that point. Having witnessed the meteoric shower of 1833 in Pennsylvania, I was particular to observe the foregoing fact. The phenomenon appeared to me to be identical with that, but far less magnificent. The day preceding had been remarkably rainy, but the night was clear and still.

"Between four and five o'clock, an *auroral arch* was to be seen in the north, and *streamers* at half past five."

II. Observations at Cambridge, Mass., published in the *Boston Courier*, Nov. 14.

"At eighteen minutes before four o'clock a large meteor darted from the north. It was quite luminous, and in size apparently equal to half the full moon. This was succeeded by many smaller meteors, and twenty three were counted by me during an hour and a half; several were seen by other persons *in the room*,* which escaped my notice. During this time one was observed of great brilliancy, having a luminous train apparently a yard in length. The lightning† continued the whole time, and there was considerable appearance of Aurora Borealis. W."

Cambridge, Nov. 13.

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* From this expression it is inferred, that the writer had but a small portion of the firmament in view.

† From light clouds in the S. E.

III. Observations at Yale College.

The preceding day had been rainy, and early the same night the sky was overcast; but before midnight, the firmament became cloudless, and the stars shone with uncommon brilliancy. My expectation of a repetition of the meteoric shower at this place was so slight, that I had made little preparation for observing the heavens, although I looked out frequently after midnight. About half past three o'clock, finding that the meteors began to appear in unusual numbers, I directed my attention towards the eastern part of the heavens, whence they appeared mostly to proceed, and closely watched the stars from the Great Bear on the north, to Canis Major on the south, embracing in my field of view about one third of the firmament.

It was soon discovered that nearly all the meteors shot in directions which, on being traced back, met in one and the same point near the eye of Leo. For a quarter of an hour from half past three o'clock, I counted twenty two meteors, of which all but three emanated from the above radiant point. Ten left luminous trains; twelve were without trains; and the three that did not conform to the general direction, moved perceptibly slower than the others. The greatest part shot off to the right and left of the radiant, the majority tending south towards the Heart of Hydra. The next fifteen minutes afforded but seven meteors, and the number gradually declined until daylight.

The exact position of the radiant was near a small star forming the apex of a triangle with the two bright stars in the face of Leo, having a Right ascension of 145, and Declination of 25 degrees.* Its place therefore was very nearly the same as in 1834, differing only half a degree in Right Ascension; and all the phenomena very much resembled those observed that year, except that they were on a scale somewhat inferior.

IV. Observations at New York. From the *New York American* of Nov. 15th.

"The annual recurrence of this phenomenon being a subject of much interest, the undersigned kept a careful watch on the night of Saturday and morning of Sunday last, and is gratified in being able to announce the re-appearance of this phenomenon with considerable brilliancy.

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* This position of the "radiant," as observed here in 1833, was in R. A. 150°, Dec. 20°; in 1834, R. A. 144° 30′, Dec. 30° 15′.

"During the evening, but few meteors were observed, but from eight o'clock until near the dawn, successive flashes were observed in the east, supposed by some to be lightning. At eight o'clock, a very beautiful auroral light was seen of a pinkish color. This continued for a short time only, although a general luminous appearance in the north remained during the night.

"About two o'clock in the morning, several meteors were seen to dart across the Great Bear, and from this time constant watch was kept up until day light. From two to three o'clock, ninety eight meteors were counted, some being very small, but the greater number of great size and brilliancy, resembling a rocket both in the explosion and trail left behind,—the trails lasting in some instances for nearly two minutes.

"With two or three exceptions, the course of the meteors was divergent from a point in Leo, Declination 20°, Right ascension 150°, nearly. The place of this point was fully confirmed during the night.

"From three to four o'clock, one hundred and fifty meteors were counted, and three hundred in all were enumerated. After this time we kept no account of the number though many more appeared. From the situation of the observer it is probable that more than half escaped notice. Several were seen in the clear light of the dawn; and Jupiter, Venus, and Mars, all shining with great brilliancy, were alternately outshone by these transient rivals. No doubt now exists in the mind of the writer, as to the distinct and peculiar character of the phenomenon; for, though an attentive observer of such matters, he has never seen any thing bearing the slightest resemblance to this display, except on the night of Nov. 12–13th, 1832, when he had the good fortune to observe the same appearance while at sea, off the harbor of Pernambuco, one year before the far famed shower of 1833. G. O. S."

V. Observations at Newark, New Jersey. From the *Newark Daily Advertiser.*

This account much resembles the foregoing, as might be expected from the proximity of the two places of observation. The writer remarks, that previous to two o'clock a few shooting stars were seen, but no more than on ordinary occasions. After that however, there was a decided increase. In an hour and a half he counted about seventy five, although his field of view took in only 60 degrees. After four o'clock, their succession was less frequent, and they continued to diminish in number until the dawn of day. He thinks the whole number that fell was not less than four hundred.

VI. Observations at Randolph Macon College, Virginia. By *Prof. R. Tolefree*, (communicated in a letter to the writer of this article.)

"On the night of the 12–13th November, three of the students and myself prepared to watch all night. The sky was serene and all was calm. About ten o'clock meteors began to appear. The first distinguished for its brilliancy, started from the lower part of the Little Bear and proceeded to the southwest. After midnight until two o'clock, all the meteors shot westward; and from two o'clock until day break their course was entirely north west. We only watched occasionally during the night, and only on the northern side of the heavens, except an occasional visit to the other parts of the building.* I counted two hundred and forty eight shooting stars, and my companions saw a larger number than this. You may safely conclude that five hundred were seen by us, and this from observations kept up only at intervals during the night."

VII. Observations made in South Carolina. From the *Charleston Courier* of Nov. 25.

"*Greenville, Nov. 19th.*—We learn that the people in the neighborhood of Maybinton, Newbury District, witnessed the fall of an immense nnmber of meteors, which first made their appearance about twelve o'clock on Saturday night last, and continued their descent until daylight the next morning. It is said their number was not near so great as that of the "Falling Stars" three years since; but the spectacle is represented as having been very brilliant and unusual."

From the foregoing accounts compared, we are led to conclude that the meteoric shower increased in intensity from north to south, that of South Carolina having been the most considerable of all, so far as accounts have reached us.

Does not the recurrence of this phenomenon for six successive years at the *same period of the year*, plainly show its connexion with the progress of the earth in its orbit? and does not the fact that the greatest display occurs every where in places differing widely in longitude, at the *same hour of the day*, as plainly indicate its connexion with the motion of the earth on its axis? The supposition of a body in space, consisting of an immense collection of meteors,

* Had Prof. Tolefree taken his station where his view of the firmament would have been unobstructed, he would probably have seen a still greater number shooting to the southwest.

stretching across the earth's orbit obliquely, so that the earth passes under it in its annual progress, while places on its surface lying westward of each other are successively brought by the diurnal revolution to the point of nearest approach, will satisfy both these conditions. I can think of no other that will. The "point of nearest approach" may be merely the extremity, or the *skirt* of the nebulous body, while the greatest part of it, and consequently its centre of gravity, lies too distant from the earth to be much influenced by its gravity. It would not be at all inconsistent with the known extent of astronomical bodies, to give to the body in question a breadth of thousands, and a length of millions of miles.

It was an accidental observation, made after the conclusion was formed, which ascribes the origin of the meteoric showers to a revolving nebulous body, that first led me to suspect the *Zodiacal Light* to be the body in question. This, according to La Place, *is* such a nebulous body, revolving around the sun in the plane of the solar equator.* We actually observe it to reach over the orbit of the earth, making an angle with its plane of only $7\frac{1}{4}$ degrees. It is not difficult to place it in such a situation that the earth shall come very near to the *skirts* of it at least. We should, indeed, expect this meeting of the two bodies to take place at the nodes of the solar equator, and therefore in December and June instead of November and April. It is easily conceivable, however, that the aphelion of the Zodiacal Light, at which place it approaches nearest to the earth, does not lie exactly at the node, but so far from it that the earth passes it a month before it comes to its node, at which time, moreover, the earth is more than a million of miles nearer to the sun than its mean distance. In endeavoring to fix the *periodic time* of the meteoric body, since it must be either a year or half a year, (for no other periodic times could bring the two bodies together at intervals of a year,†) several considerations induced the belief, that *half a year* was the true period—an inference drawn especially from the apparent great excess of velocity of the earth at the point of concourse; but the period of *a year*, (or more probably, a little less than a year,) by implying that the two bodies are always comparatively near to each other, would better explain the occurrence of shooting stars at all seasons of the year, and would be particularly favorable to the explanation of those

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* Mec. Celeste, (Bowditch,) Vol. II. 525.

† See Vol. XXVI. p. 166, of this Journal.

meteoric showers which have, on two occasions, at least,* occurred near the last of April,—a time distant about half a year from November, and therefore sustaining a like relation to the opposite point of its orbit. In such a case, meteoric showers would occur in April and November, for the same reason that the Transits of Mercury take place in May and November exclusively. The greater frequency of meteors in November than in April, naturally results from the greater proximity of the earth to the sun at the former than at the latter period; to which, perhaps, may be added, the effect of the eccentricity of the orbit of the meteoric body, the aphelion being on the side of November. In the present state of our knowledge on this subject, I regard it as a point open for inquiry, whether it will best accord with all the phenomena of shooting stars, to give to the meteoric body a period of nearly one year, or of half a year.

I have been somewhat disappointed, that astronomers should have paid so little attention to the remarkable changes which take place in the Zodiacal Light, about the 13th of November, as has been repeatedly mentioned in this Journal. It appears to me a fact deserving their attention, that the Zodiacal Light, which for weeks before the 13th of November, appears in the morning sky, with a western elongation of from 60 to 90 degrees from the sun, (while up to that time not a glimpse of it can be caught in the evening sky,) should immediately afterwards appear after the evening twilight in the west, and rapidly rise through the constellations Capricornus and Aquarius, to an elongation of more than 90 degrees eastward of the sun, while it as rapidly withdraws itself from the morning sky, and within a few days vanishes entirely from the western side of the sun. For three years past I have observed these changes with much interest, and feel warranted in asserting, that they have been repeated with uniform regularity. The present year, the light was very feeble in the morning sky, an effect partly owing to the presence and peculiar splendor of the planet Venus; but as soon after the 13th of November as the absence of the moon would permit observations, the light appeared in the west immediately after twilight, crossing the Milky Way, and rising in a pyramid almost as bright as that, the triangular space between it and the Galaxy, embracing the Dolphin, appearing, by contrast, strikingly darker.

* In Virginia, and various other parts of the United States, in 1803, and in France in 1095. Making suitable allowances for the more rapid progress of the earth through the winter signs, and for the change of style, and the Meteoric shower of the 25th of April, 1095, occurred at very nearly the opposite point of the earth's orbit.

I can account for this great and rapid change of place in the Zodiacal Light, a change which is unlike any it sustains at any other period of the year, only by supposing, that on or about the 13th of November it comes very near to us, and that we pass rapidly by it, thus giving it a great parallactic motion, an effect which is in perfect accordance with all our previous conclusions.

According to this view of the subject, *the Zodiacal Light would no longer be regarded as a portion of the sun's atmosphere, but as a nebulous or cometary body, revolving around the sun within the earth's orbit, nearly in the plane of the solar equator, approaching, at times, very near to the earth, and having a periodic time of either one year, or half a year, nearly.*

Such, I affirm, would be the fact, should the Zodiacal Light be proved to be the body which affords the meteoric showers.

Yale College, Dec. 19, 1836.

2. *Proceedings of the Maryland Academy of Science and Literature,* 1836. *March* 3.—Donations of various books for the Library were received from Prof. Ducatel and Mr. Alexander ; a diagram of the human eye from Mr. Green ; a map shewing the connection of the Baltimore and Ohio rail road, with other rail roads projected and completed, from Mr. Fisher.—Specimens were received for the Cabinet, from Mr. J. Tyson, jr., chrome ore, in a matrix said to be feldspar ; from Mr. P. T. Tyson, a large specimen of Asbestos, variety Amianthus, obtained at the intersection of the Susquehanna rail road with the Gunpowder river ; from Mrs. E. Geddings, a collection of Southern plants.—Dr. T. Edmondson, jr. reported a meteorological table for February, 1836—referred to the section of Physics, &c.—A list of minerals was submitted by Prof. Ducatel, at the request of the Consul General of France, which the government of that country is desirous to obtain—referred to the section of Mineralogy.—Don Ramon della Lagea, of Spain, and F. R. Hassler, of Washington, were elected honorary members.

March 10.—Donations of American insects were received from Mr. Hazlehurst, and of Chinese insects from Mr. Fitzgerald, which were both referred to the section of Zoology.—Mr. P. T. Tyson, from the section of Mineralogy, reported that the specimen of chrome ore, referred to that section at the last meeting, is in a matrix of magnesian carbonate of lime, the proper title of the mineral being ferro-oxide of chrome in magnesian carbonate of lime. Mr. Tyson also reported that some of the minerals required by the French Consul

General could be supplied from among the cabinets of several members.

March 17.—Numerous specimens for the cabinet were received from Messrs. Tyson, Webster, Geddings, and Hazlehurst; among them a specimen of anthracite, containing fossils, from Mr. Tyson.—Donations for the library were made by Mr. Alexander and Mr. Green.

March 24.—M. J. Cohen, Esq. presented six English birds prepared under the direction of Mr. Audubon.—Mr. P. T. Tyson presented a collection of shells, and Prof. Ducatel a large number of minerals, fossils, shells, &c.—Donations of books for the library were received from the President; and Prof. Geddings, on behalf of Dr. Barnum, presented five South American birds.—Mr. Green, from the section of Physics, reported progress on the examination of the specimens of amalgam for electrical rubbers.

March 31.—Donations for the library were received from Messrs. Alexander, T. A. Conrad, of Philadelphia, and J. E. Heath, of Richmond, and some specimens of coral and shells for the cabinet, from Mrs. Fisher.—A letter was received from the New York Lyceum of Natural History, acknowledging the receipt of the Academy's circular, and proffering duplicate specimens for the cabinet. The secretary was directed to reply and acknowledge the gratification which this prompt offer to assist has occasioned.—Dr. T. Edmondson, jr., reported a meteorological table, for March, 1836.—Mr. P. T. Tyson gave a verbal account of the Ice mountain of Virginia, and suggested the probable cause of that singular phenomenon.

April 7.—Specimens of fossil bones, from Talbot county, in this State, were presented by Dr. A. H. Bayley—also an Osprey, *Falco haliœtus*, shot in the neighborhood of this city, from Mr. Hazlehurst; several specimens were presented by Prof. Geddings. The contributions to the library were a copy of "Opinions on various subjects, by Wm. Maclure," from the author, "Synopsis of the Flora of the Western States, by J. L. Riddell," from Dr. Rogers, and a copy of the Plates to Barton's Flora.

April 14.—Dr. Harlan, of Philadelphia, presented a copy of his "Medical and Physical Researches;" Dr. James Eights, of New York—"report of the Regents of the University of the State of New York;" St. Mary's College, of this city, "Method of computing the observations of an eclipse of the sun," published by the College; and Charles Cramer, Esq. of New York, several numbers

of the "Proceedings of the Imperial Mineralogical Society of St. Petersburg."—The library was also enriched by the receipt of fifty nine numbers of the "Iconographie du Regne Animal."

April 21.—Numerous donations of books were received from Mr. E. Durand, of Philadelphia, and Dr. W. E. Coale; Dr. Edmondson presented six printed copies of the meteorological table for February last; Drs. Geddings and Riley presented for the cabinet a pair of Flickers "*Picus auratus*."—A communication in German, printed by order of the Prussian Government, containing a method for the propagation and domestic breeding of leeches, was received from Baron de Roenné, Prussian Minister, read and ordered to be translated for the library.

April 28.—Specimens were received from Mr. Minifie and Dr. Riley; and from the Academy of Natural Sciences in Philadelphia, a copy of the notice of that Academy recently published by them.—Dr. Geddings, chairman of the section of Zoology, reported progress in his examination of the foreign and indigenous insects, referred at a former meeting.—Mr. Fisher invited the attention of the Academy to a description of the aurora borealis, which was seen on the 22d of this month. The paper was referred to a committee of the section of Physics, with instructions to collect all the observations and facts connected with its appearance in this city, and report to the next meeting.—Dr. Geddings described the marine animal recently taken at Carpenter's point in the Chesapeake bay. The fish is described to be of the genus Delphinus—subgenus Delphinapterus leucas—known as the Beluga.—Mr. Fisher presented for the use of the cabinet an alcoholic solution of the arseniate of Baryta, which has been highly recommended for the preservation of cabinet specimens, especially the plumage of birds. This salt was prepared by fusing together at a moderate heat in a sand crucible, in their atomic proportions, crystallized nitrate of Baryta and arsenious acid, made into a paste with nitric acid. The process is simple, and attended with far less trouble and expense than when the ordinary process described in the books is employed.—Mr. Quinby was appointed lecturer for the regular evening.

May 5.—Specimens were received from Dr. Keener, Dr. Geddings, Dr. Riley, Joseph King, jr. Esq., and A. Trevallyn, Esq., of England, and a copy of the Statistical View of the United States, prepared under the direction of the Secretary of State, was transmitted by the Hon. R. H. Goldsborough, of the Senate.—Don Joa-

quim José da Costa de Macédo, perpetual Secretary of the Royal Academy of Sciences at Lisbon, transmitted a copy of his treatise on the early Portuguese navigators. The same gentleman, in his official capacity, addressed a letter to the Academy, inviting correspondence with the Academy which he represents, and giving information that he had sent for the library the proceedings of the Royal Academy of Lisbon. These volumes have since been received, and form a valuable acquisition to the library.—Sir Nicholas Carlisle was elected an honorary member.—Dr. Geddings, from the section of Zoology, reported a catalogue of the insects formerly referred to that section.—The first section reported as full an account as could be attained, of the late remarkable aurora borealis, which was ordered to be published.—Dr. Aiken, of the section of Botany, reported progress in the arrangement of plants.

May 12.—Dr. Geddings reported upon several specimens referred to the section of Zoology at former meetings.—Prof. Ducatel reported upon the specimens presented by Mr. Trevallyn which had been referred to the section of Mineralogy.—Dr. A. H. Bayley, of Easton, presented a fine specimen of the *Coluber eximius*, (corn snake ;) Mr. Minifie the two forefeet of a kangaroo, from New Holland ; Rev. J. J. Chauche six specimens of South American birds ; Dr. W. E. Coale several specimens of *Rana* and *Coluber*.—A memoir was read by Richard Wilmot Hall, M. D. "on the use of water as fuel," which was referred to the joint consideration of the sections of Physics and Chemistry.—Dr. Aiken proffered on deposit a large collection of geological specimens from the Erie Canal, which was accepted and the section of Mineralogy charged with superintending their removal to the museum of the Academy.—Mr. Fisher communicated the notice of a slight auroral display on the night of Sunday the 8th inst., and also information of the existence of a mineral spring in the western part of the city, containing *free carbonic acid, protocarbonate of iron, muriates of lime* and *magnesia*, and a trace of *vegetable matter.*

May 19.—Specimens were received from Dr. Cohen, Dr. Keener, and Mr. P. T. Tyson, and several works for the library from Mr. Fisher.—Dr. J. W. Gratham, of Mount Vernon, Illinois, reported a table of meteorological observations made at that place for the month of April, 1836.—Dr. Coale, from the section of Mineralogy, reported that the geological specimens had been conveyed to the museum. The section was further charged with the duty of

arranging these specimens.—Mr. Green requested the attention of the Academy to a notice in the American Journal of Science, from the Albany Institute, containing a series of observations made on the 21st of December last, with the barometer, wet and dry bulb thermometer, &c. in compliance with the proposition published in the London Athenæum, that hourly observations should be made, with those instruments, by the men of science throughout the world, on four fixed days—21st of March, June, September, and December, for thirty seven hours; and commented upon the advantage likely to result to meteorological science if the proposed observations were generally undertaken and the results compared. Whereupon it was resolved, that a committee of three from the first section be appointed, to report at the next meeting upon the most expedient means of cooperating efficiently with such other societies and individuals as may join in the proposed observations.

May 26.—Specimens of fossils, shells, insects, &c. were received from Messrs. Alexander, Tyson, Minifie, and Dr. Coale; a fine specimen of Derbyshire spar was received from Miss H. M. Davis, of Philadelphia; a handsome collection of dried lichens, from Newport, R. I. from Miss P. W. Lewis, of Philadelphia; an interesting historical relic, being part of the beam of a house erected in St. Domingo, A. D. 1492, by Columbus, was presented by D. Lewis, Esq. of Philadelphia. Several pamphlets were contributed for the library by Prof. Ducatel.—The committee appointed at the last meeting upon the subject of the meteorological observations proposed to be made in accordance with the general system proposed in Europe, submitted a report, recommending that a committee be appointed to cooperate on behalf of the Academy—that the rooms of the Academy and every facility for observation should be placed at the disposal of the committee—that the expense of procuring and constructing the necessary instruments should be defrayed by subscriptions amongst the members—that the committee have authority to call upon the members for the use of any instruments which they may possess suitable for making the proposed observations—that any interesting natural phenomena which may occur, shall be included in the table to be prepared by the committee—and finally, that a copy of the table shall be furnished for publication in the Journal of Science, and a copy to the Royal Society of London, to be disposed of as in their judgment will best promote the interests of science.

3. *Extract from the Meteorological Register of Prof. Barton, kept at New Orleans;—average for three years, beginning August* 1, 1833, *and ending July* 31, 1836.

MONTHS.	THERMOMETER. Average at sunrise.	Average of dew point.	Average at midday.	Average in the sun.	Average at sunset.	Average at 10 o'clock at night.	Highest.	Lowest.	Mean for the month.	Range.	BAROMETER. Average at sunrise.	Average at midday.	Average at sunset.	Average at 10 o'clock at night.	Highest.	Lowest.	Mean for the month.	Range.
January, - - - - -	49.06	.	56.85	.	55.32	51.91	72.00	28.66	53.54	43.33	30.01	30.01	29.98	30.00	30.23	29.70	30.00	.53
February, - - - - -	45.29	.	58.65	.	52.03	49.72	72.66	76.66	51.42	46.00	29.65	29.98	29.96	29.47	30.20	29.75	29.94	.44
March, - - - - -	55.16	.	62.65	.	60.44	56.85	75.66	46.00	59.02	29.66	30.02	29.98	29.96	29.97	30.23	29.82	29.98	.47
April, - - - - -	62.78	58.00	70.82	.	68.40	61.66	80.00	54.00	66.75	26.66	30.04	30.00	30.02	29.91	30.17	29.76	30.00	.41
May, - - - - -	68.37	70.00	78.09	105.00	76.16	71.73	86.00	60.00	75.58	26.00	30.01	30.00	30.02	30.01	30.17	29.85	30.00	.32
June, - - - - -	76.49	66.24	83.68	103.50	80.83	78 01	89.00	72.00	79.75	17.00	30.01	30.03	30.01	30.02	30.14	29.88	29.99	.27
July, - - - - -	76.75	68.52	83.79	103.33	81.42	78.41	88.66	73.00	80.06	15.67	30.03	30.04	30 03	30.04	30.14	29.95	30.03	.19
August, - - - - -	76.91	68.00	82.33	108.00	80.03	78.45	89.00	73.00	80.16	16.00	29.88	29.89	29.86	29.87	30.02	29.78	29.87	.24
September, - - - - -	74.22	64.00	80.37	92.00	77.11	75.17	83.66	64.66	77.22	19.00	29.89	29.90	29.90	29.87	30.07	29.74	29.88	.32
October, - - - - -	62.82	58.00	73.01	.	71.01	67.45	82.00	47.16	68.55	35.50	29.97	29.96	29.96	29.86	30.19	29.83	29.96	.37
November, - - - - -	55.83	60.00	65.31	.	63.77	58.86	77.33	34.00	59.64	43.33	29.98	29.98	29.98	29.97	30 31	29.69	29.97	.58
December, - - - - -	48.36	.	59.88	.	57.58	53.43	71.00	35.33	54.97	35.67	29.94	29.98	29.97	29.87	30.20	29.78	29.99	.41
Total averages, - - - -	62.67	.	71.30	.	68.63	65.14	.	.	67.22	29.48	.	.	.	.	.	.	29.96	.40
BY SEASONS.																		
Winter average, - - - -	47.57	.	58.46	.	54.98	51.69	72.66	28.66	53.31	41.66	.	.	.	.	.	.	.	.
Spring " - - - -	62.10	.	70.52	.	68.23	63.41	86.00	46.00	67.12	27.47	.	.	.	.	.	.	.	.
Summer " - - - -	76.72	.	83.27	.	80.76	78.29	89.00	72.00	79.99	16.56	.	.	.	.	.	.	.	.
Fall " - - - -	64.29	.	72.89	.	70.63	67.13	83.66	34.00	68.47	32.61	.	.	.	.	.	.	.	.

Meteorological Register—continued.

MONTHS.	HYGROMETER.								ASPECT OF THE WEATHER. Observations per diem.				WINDS. Observations per diem.								RIVER.	
	Average at sunrise.	Average at midday.	Average at sunset.	Average at 10 o'clock at night.	Highest.	Lowest.	Mean for the month.	Range.	Clear.	Cloudy.	Rainy.	Average quantity of rain. Inch.	North.	Northeast.	East.	Southeast.	South.	Southwest.	West.	Northwest.	Deposit in rain water.	Average retrocession from high water mark. Feet.
January, -	26.50	15.50	17.50	22.50	43.50	0.00	19.50	43 50	43.66	34.33	13.33	4.66	17.00	5.33	7.33	8.33	8.33	7.33	9.00	14.66	Averaging 3-4ths of a line in 10 inches of water.	7.90
February, -	27.00	12.50	15.50	16.00	40.00	0.00	31.00	28.00	51.33	14.44	8.33	2.25	13.00	6.00	4.33	5.33	3.66	12.00	8.66	13.66		5.13
March, -	27.50	12.00	16.00	21.00	40.50	0.00	18.87	40.50	45.33	36.66	10.66	2.59	15.00	12.00	4.33	7.33	14 00	9.33	5.66	11.00		4.27
April, -	47.44	37.12	42.57	44.21	61.33	17.66	42.25	43.66	54.00	23.00	12.33	6.21	5.66	5.33	6.33	16.35	14.00	13.66	3.00	8.66		2.94
May, -	54.54	35.85	41.92	51.21	61.61	14.00	45.78	47.00	69.00	18.00	8.00	2.95	4.00	13.66	7.66	13.66	7.00	20.33	3.00	7.66		4.63
June, -	57.48	37.88	45.72	49.87	66.66	23.33	48.65	40.00	59.33	17.33	11.66	6.16	5.00	5.00	5.00	15.66	10.33	23.33	6.33	9.00		4.72
July, -	44.11	24.54	35.21	41.96	52.00	0.00	36.54	52.00	54.33	22.00	15.00	6.38	67.33	7.66	11.33	13.00	10.66	10.33	6.00	9.33		5.82
August, -	49.00	30.00	40.00	41.00	56.00	5.00	40.00	51.00	51.39	18.70	11.76	5.72	6.00	9.00	5.33	10.00	6.00	20.33	7.33	8.66		7.97
September,	60.35	44.86	45.66	49.20	65.00	26.00	46.77	39.00	56.73	11.83	10.83	5.66	9.00	19.66	12.66	13.66	6.50	5.50	3.50	11.00		13.10
October, -	46.12	31.91	34.23	43.50	61.50	1.00	40.60	66.00	66.43	12.70	3.03	1.37	20.33	11.33	10.66	9.33	5.00	4.50	3.50	10.00		13.33
November,	24.78	20.63	26.41	34.75	52.50	0.00	28.98	52.50	57.73	43.86	7.17	3.18	14.00	4.66	6.33	7.66	8.00	3.33	10.33	13.33		12.34
December,	28.30	14.91	17.19	29.50	48 00	0.00	21.22	48.00	50.73	23.30	6.80	2.87	9.00	10.33	7.50	5.50	4.33	9.33	10.66	18.00		8.84
Total averages,	.	.	.	.	.	.	.	.	54.99	23.01	9.90	50.00	.	.	.	.	.	.	.	.	.	.
								Days,	219.99	92.05	39.63											
BY SEASONS.																						
Winter average,	.	.	.	.	.	.	.	.	48.61	24.02	9.48	9.78	39.00	21.66	15.16	19.16	16.32	9.55	9.44	15.44	.	.
Spring "	.	.	.	.	.	.	.	.	56.11	29.22	10.33	11.75	8.22	10.33	6.11	12.45	11.67	14.44	3.89	5.77	.	.
Summer "	.	.	.	.	.	.	.	.	55.02	19.34	12.81	18.26	5.78	7.22	7.22	12.89	8.99	17.99	6.55	8.99	.	.
Fall "	.	.	.	.	.	.	.	.	60.29	22.79	7.01	10.21	14.44	11.88	9.88	10.22	6.50	4.44	5.78	11.44	.	.

N. B. The period embraced in the above extract, includes a part of our epidemic year, in which the extremes of temperature were unusually great. The first two winters, also, were unusually cold. The dew point was taken from half an hour to an hour after sunrise. That in the sun, between 2 and 3 o'clock.

Communicated by Prof. J. Griscom.

4. *Properties of Liquid Carbonic Acid;* by M. Thilorier.—Within the walls of Faraday's tube is a new chemical world, the phenomena of which are totally unexpected: to mention at this time only liquefied carbonic acid, whose properties, in common with permanent liquids—dilatation, vaporization, &c.—are exalted, amplified, and developed upon a scale truly gigantic.

Dilatation.—This liquefied gas presents the strange and paradoxical fact of a liquid more dilated than the gases themselves; from 0° to +30° Cent. its volume is increased from 20 to 29; that is to say, at +30 Cent. the *increase* of volume is nearly equal to the half of its volume at 0°; in a word, its dilatation *is four times greater than that of air,* which from 0° to +30° Cent. would be dilated only $\frac{30}{267}$, whilst the dilatation of liquid carbonic acid, reduced to the same scale, is $\frac{116}{267}$.

Vaporization.—If we raise the temperature of a tube containing a thin stratum of liquid carbonic acid, it enters into ebullition, and the empty space above the liquid is saturated with a quantity of vapor which increases with the temperature. At +30° Cent. the quantity of liquid at 0° necessary to saturate the empty space, is represented by a stratum of liquid equal to a third of the space in which the evaporation was effected. At 0° the stratum of liquid of saturation is only $\frac{1}{12}$ of the space saturated.

Pressure.—From 0° Cent. to +30° the pressure of the vapor furnished by the liquefied gas rises from 36 atmospheres to 73; which gives *an increase of one atmosphere for each centigrade degree.* It is necessary to observe, that the weight or density of the vapor increases in a much greater proportion than the pressure, and that the law of Mariotte does not apply within the limits of liquefaction; if we took the density of the vapor for the basis of pressure, the pressure at +30 Cent. would be equal to 130 atmospheres, while the manometer indicates really but 73.

Thermoscopic effects.—If we subject to the action of heat a tube of glass containing a stratum of liquid and another of gas, two contrary effects will appear.

1. The liquid will increase by dilatation.
2. The liquid will diminish by vaporization.

The thermoscopic effects will be very different according as the liquid stratum is greater or less than the gaseous stratum: hence *the*

application of heat may cause the liquid to dilate, to contract, or remain stationary.

These anomalies have furnished the means of verifying the numbers which the preceding researches had given relative to dilatation and vaporization. According to these numbers, the point of equilibrium above what the liquid increases and below what it diminishes by the addition of heat, results from such a proportion between vacuity and fullness that at zero the stratum of liquid occupies $\frac{13}{30}$ of the whole tube. If the liquid occupies at zero the third of the tube, we have *a retrograde thermometer whose fluid increases by cold and diminishes by heat.* If the liquid occupies at zero two thirds of the tube, we have *a normal thermometer,*—one in which the fluid increases and diminishes according to the laws of dilatation. The play of this thermometer is limited to +30 Cent.; for at this temperature the tube is entirely filled by the liquid.

A thermometer of this kind would have a great advantage over common thermometric instruments, in determining the temperature of cellars and similar places below +30° Cent.

Specific gravity.—Liquefied gas, whose specific gravity at 0° is .83, (water being taken for unity,) presents the *unique* phenomenon of a liquid, which, from −20° to +30 Cent. runs over the scale of densities from .90 to .60.

Action of liquid carbonic acid on other substances.—While it remains liquid it is *absolutely insoluble in water,* with which it does not mix, but floats above it. It is the same with respect to the fat oils.

It is soluble in all proportions in alcohol, ether, naphtha, spirits of turpentine, and carburet of sulphur.

It is decomposed, when cold, with effervescence by potassium; it has no sensible action on lead, tin, iron, copper, &c.

Cold produced by liquid carbonic acid in its transition from the liquid to the gaseous state.—When a jet of the liquid acid is directed upon the bulb of an alcoholic thermometer, it rapidly sinks to −90° Cent. But the frigorific effects do not respond to this abasement of temperature, a fact which is explained by the almost absolute want of conducting power of the gases and their low capacity for heat; hence the *intensity* or *tension* of cold is enormous, but the sphere of activity is limited in some sort to the point of contact. The congelation of the mercury is confined to small portions of it, and if a finger is exposed to a jet of the liquid a sensation of burn-

ing is indeed forcibly felt, but the effect is chiefly confined to the epidermis.

If gases have little effect in the production of cold, it is not so with vapors, whose conductibility and capacity for heat are much greater. I have therefore thought that if a permanent liquid,—ether, for example—could be placed under the same condition of expansibility as liquefied gases, we might obtain a frigorific effect much greater than that procured by liquefied carbonic acid. To accomplish this, ether must be rendered *explosible*, and this I have easily effected by mixing it with liquid carbonic acid. In this intimate combination of the two liquids, which dissolve each other in all proportions, ether ceases to be a permanent liquid under atmospheric pressure; it becomes expansible like a liquefied gas, still preserving its properties as a vapor—viz. its *conductibility* and capacity for caloric.

The effects produced by a blowpipe fed by explosible ether are remarkable: a few seconds are sufficient to congeal fifty grammes of mercury in a glass capsule. If we expose a finger to the jet which escapes from this *veritable blowpipe of frost*, the sensation is quite intolerable, and seems to extend much farther from the point of contact than with the liquid jet.

I propose to replace ether by *carburet of sulphur*, which will in all probability produce still more striking effects.—(Annales de Chim. Decem.)

5. *Solidification of Carbonic Acid*,* by M. Thilorier.—I had the honor, at the last session, to state to the Academy the phenomena which accompany the liquefaction of carbonic acid gas: I now announce the fact, important to science, of the solidification of this gas. This first instance of a *gas becoming solid and concrete*, is so much the more remarkable, as it relates to a gas which requires the most powerful mechanical action to attain liquefaction, and which resumes with greater rapidity its first form when the compression is removed.

Gaseous under the common temperature and pressure, and liquid at zero, under a pressure of 36 atmospheres, carbonic acid becomes solid at a temperature about the hundredth degree (Cent.) below melting ice, and retains this new condition for several minutes in the open air, and without the necessity of any compression.

* Mentioned in the last No. of this Journal, p. 163, but the details are now given.

Whilst in the liquid state, its elastic force is under such energetic restraint that a gramme of this substance produces an explosion as great as the same weight of powder: this *spring*, in the solid state, is completely broken: the new body disappears insensibly by slow evaporation.

A fact not less curious than the solidification of this gas, is, that it is effected by the sudden passage from the liquid to the gaseous state, and that the *approach and coherence of the molecules* which constitutes the solid state, is caused by the expansion of a liquid which instantly occupies a space 400 times greater than its primitive volume.

A fragment of solid carbonic acid, slightly touched by the finger, glides rapidly over a polished surface, as if sustained by the gaseous atmosphere with which it is constantly surrounded until it is entirely dissipated.

If we introduce a few decigrammes of this substance into a little flask, and stop it hermetically, the interior is filled with a thick vapor, and the stopper is soon driven out with violence.

The vaporization of solid carbonic acid is complete. It leaves but rarely a slight humidity, which may be attributed to the action of the air on a cold body, whose temperature is much below that of freezing mercury.

The influence of cooling upon liquid carbonic acid, whose expansive force is thus found to be annihilated at about the hundredth degree (Cent.) below melting ice, begins to be manifest at a much higher temperature: this expansive force, which at zero is equal to 36 atmospheres, is no more than 26 atmospheres at 20° below zero.

It seems proper to add, that the term one hundred degrees below zero, which I assign to the solidification of the liquid acid, is not hypothetical. In the experiment which I made before the members of the committee, the alcoholic thermometer sunk to —87°; and by adding to these 6 degrees, which the fluid would have contracted if the whole thermometric column could have been subjected to the frigorific action, we shall have the actual temperature of 93° Cent. below 0°, and this number cannot have been the maximum of the effect of the blowpipe fed by liquid carbonic acid.—*Idem.*

6. *Exchanges of objects in Natural History.* (Extract of a letter from Dr. H. G. Bronn, to Prof. Silliman, dated Heidelberg, Germany, 13th June, 1836.)—The museum of Natural History con-

nected with the University at Heidelberg, which for the present has been placed under my direction, is desirous of making exchanges of objects in Natural History, and more especially in Zoology, with some similar public institutions, or private individuals, in the United States. The number of specimens from the United States, at present in this country, is so very small, that duplicate specimens of any and every object, even the most common and least valued, would be acceptable. A list of desiderata is therefore unnecessary. Every thing that may be sent will here be highly valued. It may be remarked, however, that the packages should be large, in order to be proportioned to the expense of transportation, and also that the specimens should be well preserved and carefully secured.

There may be perhaps some persons, friends of science, now absent from Europe for a time, who, considering the many difficulties which this museum must encounter in procuring objects in Natural History from the various parts of the globe, may feel inclined to transmit to us, without a compensation in return, collections of shells, insects, crustacea, arachnides and other objects, which require but little care in their preservation.*

The society or societies, which may be disposed to accept of our invitation, are requested to name their desiderata; and also those who have specimens for sale, are desired to send us a list of them, with the prices attached.

All objects intended for the museum may be transmitted to Mr. Ph. Lajeune, of N. York; or Messrs. Wanner, Langest & Co., at Havre.

P. S. The museum would also offer to expose for sale any objects that may be sent out with that design; and if it is desired to establish in Germany a place of depot for the sale of American objects in Natural History, we would strongly recommend Heidelberg as peculiarly favorable, it being situated in the most frequented part, and on the most travelled route of Germany; and moreover, it contains at present no similar establishment. We would correspond farther on this subject with any who may be pleased with this project.

7. *The Dispensatory of the United States of America;* by George B. Wood, M. D., Prof. Mat. Med. and Phar. Univ. Penn., Mem.

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* For the preservation of insects, arachnides, crustaceous animals, small reptiles and fishes, it is sufficient to put them in bottles or small kegs filled with rum, or with alcohol diluted one half with water, and so securing them as to prevent their moving. Previous to sending them, this vessel should be carefully enveloped.

Am. Phil. Soc., &c. &c.; and Franklin Bache, M. D., Prof. Chem. Phila. Col. Phar., a Sec. of Am. Phil. Soc., &c. &c.: 3d Ed., enlarged and carefully revised. Philadelphia: Grigg & Elliot, 1836.—The rapid sale of two editions of this work, has induced its authors to enlarge and improve it still farther. It is now the fullest in its details, and the most correct and best arranged, and therefore the most authoritative work of the kind in the English language. That this book of reference was deemed necessary, is now clear, from the avidity with which it was sought for on its first appearance, and the publication of a second and third edition proves that it is now considered as necessary to the physician who wishes to prescribe intelligently and accurately, especially in regard to proportions and modes of combination of medicines. If this be true of a city physician, for whom officinal combinations can be always promptly obtained in the shops, how much more strongly must this be experienced by a country practitioner, who makes up his own prescriptions, and often prepares his own extracts, tinctures, infusions and ointments. No memory is equal to the task of treasuring up for use, the proportions and mode of combination of numerous and diversified medicinal substances, which, in the progress of a case of disease, are thought worthy of trial. This difficulty is removed by the learning, industry, patience and good faith of the authors of this Dispensatory.

Among the alterations and improvements of the present edition, is the transfer of all non-officinal substances from the body of the work to the Appendix.

The following additional articles are inserted in the Appendix; viz. Alcornoque; Calotrapis Gigantea or Madar; Catalpa Cordifolia; Chlorides of potassa and soda; Codfish oil; Creosote; Cyanuret of potassium; Cyanuret of zinc; Dippel's animal oil; Ferrocyanate of potassa; Iodide of ammonium; Iodide of iron; Iodide of sulphur; Iodo-hydrargyrate of potassium; Irish moss; Artificial musk; Nitrate of soda; Oil of Euphorbia; Sassa gum; Soot. The Appendix is still farther enriched by a copious alphabetical table of pharmaceutical equivalents, which appears in it for the first time.

The requisite corrections in fact and opinion, throughout the work, are introduced, and the authors have endeavored to make it the reflexion of the knowledge of the day: both the paper and type are also improved in this edition.

Based as this Dispensatory is on the Pharmacopœia of the United States, it is a national work, tending to establish a common standard

of pharmaceutical nomenclature and preparations, and thus greatly to facilitate the free interchange of experience among our physicians respecting the effects of medicines, as well in their simple form, as in officinal combinations and common extemporaneous prescriptions.

8. *Antiquities.*—We earnestly invite the public attention to the following important notice of American antiquities.

Mr. Editor,—Having just received a letter from the secretary of the Royal Society of Northern Antiquaries, relative to the work on America, upon which they have been for many years engaged, and deeming that the information it contains may be interesting to those who have subscribed* for the work, and may be the means of inducing others to do the same, I have made extracts from it, and you will oblige me by giving publicity to them through the Journal.

I would also reiterate the request of Prof. Rafn, that the periodicals and journals of the day would copy the announcement here made, in order that the very limited encouragement thus far offered by us to the Danish Society, may be extended to a degree commensurate with the importance of the publication, and the labor by them bestowed upon it.

The subject of the early history and antiquities of America, is daily attracting more and more attention; and among the philosophers and antiquarians who have enlisted in the cause, those associated with and belonging to the Society established at Copenhagen stand pre-eminent for their laborious investigations, their long continued and unwearied inquiries, their deep and extensive researches, and more than all, for the success which appears to have crowned their efforts.

Many seem to think that all which can be satisfactorily known in relation to this matter, is embodied in the second chapter of Wheaton's History of the Northmen.

But as interesting as the intelligence there communicated is, the account is a brief one, and made subsidiary to his main design; the distinguished author having for his object the elucidation not of *American* history, but that of the *Danes* and *Normans.*

All that relates specially to this country, is embraced in less than eight octavo pages, whereas the Society's work will contain several hundred quarto pages.

* Yale College has ordered a copy for its Library.

With regard to the individuals engaged in the undertaking, it is sufficient to say, that among the most prominent are those to whom Mr. Wheaton acknowledges his indebtedness, and of whom he speaks in terms of commendation. They were, many years previous to the appearance of his valuable publication, occupied with the task, and they have been diligently engaged therewith ever since its appearance, which was more than five years ago.

During the latter period, many important discoveries have been made in Greenland and Iceland, bearing upon our history; the vast collections of manuscripts in Copenhagen have been more critically examined; collections so extensive that the life of no one individual would be sufficiently protracted to enable him to make a thorough examination of them, and consequently could only be mastered by a union of effort, like that which has been devoted to it. In addition to other materials to which the Society has had access, are "*not a few parchment codices, never before employed or even known to exist.*"

It may be necessary to add once more, for the information of those who have not seen the original prospectus, that the work here alluded to, "will be published in the original Icelandic, with accompanying Latin and Danish versions, and will be furnished with a critical apparatus of variorum readings, explanatory notes, (in Latin,) with one chronological and several genealogical tables, and geographical and archæological disquisitions respecting the first landing places and earliest settlements of the Northmen in America, and the vestiges of their migration to, and sojourn in this country; disquisitions towards which material assistance has been furnished by several men of science and erudition in the United States. A summary of the work, in English, or French, will be delivered gratis to the subscribers; its size to be regulated by their number. The work will consist of one volume royal quarto, and will be furnished, in America, at twelve dollars per copy, including the freight from Denmark to New York or Boston. Forty copies have been struck off on thick imperial vellum, at a proportionally higher price."

Individuals wishing the work, may transmit their names and address to the subscriber.

Subjoined are the extracts to which we called your attention.

Respectfully yours,

THOMAS H. WEBB.

Providence, September 12, 1836.

Copenhagen, July 9th, 1836.

Dear Sir,—The printing of our announced work will, we hope, be entirely finished in the course of a few months. The delay that has taken place in forwarding to you and other gentlemen the prospectus issued by us, will prevent our receiving the subscriptions in season to transmit copies of the work this fall.

Along with this, I send a written supplementary notice, which I request you will prevail on some of the publishers of the most extensively circulated papers and periodicals to insert.

Antiquitates Americanæ.—On the 19th November last year, the Royal Society of Northern Antiquaries, issued a prospectus, of a collection of the accounts extant in ancient Icelandic and other Scandinavian Manuscripts, relative to *Voyages of discovery to North America made by the Scandinavians in the* 10*th and following centuries.* It is hoped that this prospectus has already been published in America; and the following supplementary notice is now added to it.

This work will now soon be issued from the press. A circumstance that occasioned considerable delay, was the engraving of the fac similes, which was rendered very laborious by the uncommon darkness and illegibleness of the parchments; but which is now at length finished. The work will be illustrated by eighteen plates in all, viz. eight large fac similes, four maps on which are given the Old Northern names of countries and places, and six other engravings.

From communications made to us by several of the Society's members in America, we learn that an English translation would be highly acceptable. Whether this will be undertaken or not, must be left for future consideration; and will mainly depend upon the patronage furnished to the original work.

No translation however can be equivalent to, or render superfluous the original Old Northern or ancient Icelandic text, which all cultivators and admirers of the history of the Ante-Columbian epochs of America will now have it in their power to consult; and by means of its immediate study, they will be able to come to a clear conviction of the importance of the accounts contained in the ancient manuscripts of the north.

We would remark, that in the main work itself, several important elucidations, received from learned men in America, are inserted in the English language, as it is to be presumed that the greatest number of readers will prefer perusing them in that tongue.

In the expectation that the announced work will obtain that attention in the United States to which writings, so remarkable and so rich in the historical records of a period long since passed away, have so well founded a claim, we take this opportunity to inform such as wish well to the undertaking, that notices of subscription may be sent to either of the three following members of the Society, viz.

Thomas H. Webb, M. D. Providence, R. I.
Rev. Charles Lowell, Boston, Mass.
John R. Bartlett, Esq. New York.

It is requested that the notices may be sent as soon as possible, as these gentlemen will in January transmit us the several names, in order that the work may be forwarded early in the spring.

Publishers of Journals and Newspapers in the United States are earnestly solicited to contribute their aid to the furtherance of this object, by the insertion of the above, and they will thereby confer an obligation upon the Royal Society of Northern Antiquaries.

Charles C. Rafn, Secretary.

To Thomas H. Webb, M. D.

9. *Agency for Patents, at the city of Washington.*—Dr. Thomas P. Jones, of Washington, formerly superintendent of the Patent Office, will hereafter devote himself to the business of preparing specifications and drawings, and to other transactions connected with the obtaining of patents for useful inventions. His long acquaintance with theoretical and practical mechanics and chemistry, and with the progress of the useful arts, both at home and abroad, will enable him to decide upon the novelty and utility of machines or processes which it is proposed to patent; a circumstance always of great importance, but now rendered peculiarly so by the provisions of the new patent law. He is also familiar with the practice of the courts of the United States relating to patents, as well as with the patent laws of England, France, &c., and can furnish the information which may be required on these points generally. Those persons who wish to procure patents in foreign countries may do so through his agency, or obtain such preliminary information as may be deemed requisite, either from himself, or through his confidential correspondents abroad.

In all cases where specifications are to be drawn up, good drawings or a model should be forwarded, together with such a description of the invention as will make its design fully known. Models are re-

quired to be deposited in the office previously to the granting of a patent for any machine; and although these, when simple, may be made in Washington from a good drawing, it will always be more satisfactory to have them sent by the applicant. When drawings are forwarded, they should be signed by the applicant, and be witnessed by two persons.

All letters making inquiries respecting patents must be post paid; and where examinations in the Patent Office or elsewhere, or written opinions, are required, a fee of five dollars will be expected. The charge for specifications and drawings must depend upon their complexity, but will be moderate.

P. S.—Dr. T. P. Jones will act as agent in business to be transacted at the public offices in Washington, or with individuals.

10. *Excursions to Cairo, Jerusalem, Damascus, and Balbec, &c.*, by George Jones, A. M., Chaplain U. S. Navy: Author of Sketches of Naval Life. New York: Van Nostrand & Dwight, 1836: pp. 388, large 12mo.—This very instructive and beautiful book is just such a production as might be expected from the author, who is well known by his former spirited and graphic work.

As a traveller, Mr. Jones unites great activity, curiosity and tact, with the knowledge which is necessary to prompt and direct his observations. Such are his powers of narrative, of description and illustration, that he makes his reader a gratified and grateful party to his travels; he carries you along with him, and inspires you with a share of his own enthusiasm.

In the present instance, the scene is laid in countries long venerable and venerated, as the cradle of knowledge, of religion, of arts, of dominion: we cannot know too much of Egypt and Palestine, of the Nile, of the Pyramids, and of the Holy City.

In the case especially of the latter, Mr. Jones has been happy in separating truth from error, and we are strongly impressed with the conviction that the most important localities of Jerusalem are now well ascertained, and are clearly indicated by him.

In support of the authority of Mr. Jones' book, there is at present a happy and very unexpected coincidence between the facts which he has stated, and very satisfactory evidence derived from another source. We allude to the valuable lectures of Mr. Catherwood, accompanied by fine illustrations from his own pencil, industriously employed, during a course of four years in Palestine, Syria and Egypt, to exhibit the wonderful antiquities and scenery of those

countries. Mr. Catherwood himself, every way a highly qualified judge, pronounces Mr. Jones' work to be exceedingly correct. As Mr. Jones possesses much and various knowledge of other countries in which he has travelled, we cannot prove, in any way, more decisively, our confidence and satisfaction in his work, than to say, that in our judgment he cannot do better than to go on and tell the world, if not like Johnson, *all that he knows*, certainly *some share* of that part which remains untold.

11. *Gold Mines of Virginia.*—For want of room, we are compelled to postpone an article on the gold mines of Virginia, which we intended to insert, (the facts being drawn chiefly from our own personal observation, made among the mines during the late autumn.) We are satisfied of the great value of some of the mines, and that many are worthy of a sober and rational exploration.

There is, without any doubt, much gold in Virginia, diffused through an extensive tract; and there is great reason to believe that there are still many places in the same geological and geographical region, in which it lies undiscovered, and is still to be brought to light; we hope to add more in our next number.

12. *Exchanges in Conchology.*—Dr. J. C. Jay, 22 Bond street, New York, has recently published a second and improved edition of his Catalogue of Recent Shells, with descriptions of new or rare species, illustrated by four colored plates.

Dr. Jay's collection is well known for its extent and beauty, and for the excellence of its arrangement. We are given to understand that it will "give him pleasure to exchange duplicate specimens, and that he will receive *live and perfect* shells, whether they are enumerated in his catalogue or not; and as far as he is able, he will supply whatever may be desired in return."

13. *New Work on Mineralogy.*—A Treatise on Mineralogy, by James D. Dana, A. M., assistant in the department of Chemistry, Mineralogy and Geology in Yale College, is in press in this city, and will be published in about three months. It will comprise an extended introduction, together with full descriptions of species, and an appendix upon the application of analytical geometry to the science of Crystallography. The work will constitute an octavo volume of about 450 pages, and will be illustrated by 200 wood cuts, and four copperplates containing 150 additional figures. It will be published by Durrie & Peck, and Herrick & Noyes.

14. *Statistical View* of Chemical Education in the town (or city) of ——.*

Professor's Name.	Age.	Department of Chemical Science he illustrates.	In what University, College or School?	Is the salary fixed or variable?	Is instruction given in any other branch of Natural History?		How many courses per year?		How long does each course continue?	Price of tickets of each course?		Number of students at each course?		Is the number of students increasing or diminishing?	In the University or School.		Are there in or about the town (or city) any chemical manufactories on a grand scale, and how many and what?	At what period were they established, generally?	Number of artificers.	Population of the place.	REMARKS.
					In what?	Or where?	Public.	Private.		Public.	Private.	Public.	Private.		Number of Medical Students?	Number of general Students?					

* Received from Prof. Johnston, of Durham, England, with a request that it may be republished in this country; it is desired that the blanks may be filled, and the returns may be published in this Journal.—Ed. Please add (?) to answers that are doubtful.

15. *History and Proceedings of the Mechanics' Institute of the City of New York, from the Corresponding Secretary.*—The New York Mechanics' Institute was founded in the spring of 1831, and originated in a class of Mechanics attending a course of lectures on Chemistry and Natural Philosophy given by Prof. John Steele during the preceding winter, and consisted of forty-five members. In October of the same year, the Common Council of the city granted the free use of the rooms now occupied by the Institute, in the basement story of the City Hall, consisting of a Lecture Room, Reading Room, Library, and a place for the deposit of Models of Machinery. The Institute has rapidly increased in numbers, until it enumerates above one thousand active members. The advantages which it offers to the members are a free ticket of admission to its annual exhibition and fair, generally held in September, to its lectures, and the use of its library and reading room, at an expense of four dollars for the first year and two dollars a year afterwards. The lectures are held during the winter months twice in the week, on a variety of subjects connected with the mechanical professions. The Library, containing between ten and eleven hundred volumes, is well selected and free to the members. The Reading Room contains above fifty periodicals, amongst which are found the most important literary and scientific journals that are published in the English, and a few in other languages. The celebrated work on Egypt got up under the French Government, has been procured by subscription amongst the friends of the institution, at an expense of $800, and is now deposited in its Library. The Institute holds a meeting for the transaction of its business the first Tuesday evening of each month, and every other Tuesday evening of the month is occupied by a lecture or an essay from some one of the members. The scientific meetings have been but recently commenced, and promise the most happy results. The following is an abstract of the proceedings.

Tuesday, Oct. 11*th*, 1836.—The meeting was opened by the Cor. Secretary, who stated that it was one of the prominent objects of these meetings to communicate the various desiderata in the present state of the arts; to obtain, as far as practicable, histories of the origin and progress of the various trades, as well as of the individual articles manufactured by the various artificers—such as the history of pumps, stoves, mills for grinding grain, windmills, water mills, &c. The importance was particularly urged of investigating the

history of unsuccessful patents and of inventions not patented, in order to prevent the time and labor so frequently lost by inventing that a second time which has been long ago invented, thrown aside as useless, and forgotten. A complete set of Harper's Family and Classical Library, 99 vols. 18mo. was received, a joint donation from Geo. Bruce, Esq. President of the Institute, and the Messrs. Harper & Brothers.

Oct. 18.—James J. Mapes, Esq. gave a lecture on the origin and progress of Phrenology. The Cor. Sec. read a letter from Mr. Ouidinot, of Pottsville, Pa. accompanied with a box of fossils, &c. illustrative of the coal formation of that neighborhood, for which thanks were recorded.

Oct. 25.—L. D. Chapin, Esq. read an essay on the geology of some parts of Virginia, especially in the vicinity of the Natural Bridge, in which he gave some new measurements made by himself. A suite of minerals was presented by Dr. Feuchtwanger.

Nov. 8.—Dr. R. Crandall gave a lecture on Assimilation, accompanied by valuable practical remarks on dietetics.

Nov. 15.—Thos. Ewbank, Esq. gave a lecture on the history of Syphons, in which he exhibited a number of new ones invented by himself. Mr. Chapin exhibited some remarkable specimens of wood from the city of Hartford, Conn. with the marks of edged tools upon them, and specimens of leaves, all of which were excavated about 40 feet below the surface.

Nov. 22.—The President gave a lecture on the history of Printing, illustrated with a great variety of specimens of the various fashions of letters and work from the origin of the art down to the present time, which from the request of many members, will be repeated on the 8th of December.

Nov. 29.—The exercises of the evening were opened by remarks from Dr. Gale on the materials generally used for building in different countries, with the effect of climate, and especially its agency in decomposing or disintegrating the materials used. After which James Frost, Esq. made some appropriate remarks on the comparative methods of building in England and in the United States. The Cor. Sec. of the Institute announced that the associate course of lectures would be opened by the President on the 8th of December, and presented a list of the names of the gentlemen who will lecture, as follows:

December 8—Geo. Bruce, Esq. Pres. Institute, on History of Printing.
" 12—J. R. Bartlett, Esq. on the Varieties of the Human Race.
" 15—Dr. Wallace, on the Hand, the Brain, and their uses.
" 19—Geo. Bruce, History of Printing, *(concluded.)*
" 22—J. R. Bartlett, Varieties of the Human Race, *(concluded.)*
" 26—Dr. Wallace, on the Ear, the Tongue, &c.
" 29—Prof. Torrey, on Gas Lights.
January 2—Dr. Wallace, on the structure, &c. of the Eye.
" 5—Thos. S. Cummings, Prof. of National Acad. Design, on the advantages of the Arts of Design to the Useful Arts.
" 9—J. J. Mapes, Prof. Nat. Phil. and Chem. National Academy Design, on the Chemistry of Colors.
" 12—A. Mills, Esq. on the Commerce, &c. of Ancient Tyre and Sidon.
" 16—Wm. Dunlap, Vice President National Academy Design, on Early History of New York.
" 19—A. J. Mason, Esq. Prof. National Acad. Design, on History and Practice of Engraving on Wood.
" 23—A. Mills, Esq. on the Commerce, &c. of Ancient Tyre and Sidon, *(continued.)*
" 26—Prof. Mason, on History and Practice of Engraving on Wood, *(continued.)*
" 30—J. Catherwood, Esq. on History and Antiquities of Egypt.
February 2—Prof. Mason, on History and Practice of Engraving on Wood, *(concluded.)*
" 6—J. Catherwood, Esq. on History and Antiquities of Egypt.
" 9—Dr. Crandall, on Animal Mechanics.
" 13—J. Catherwood, Esq. on Hist. and Ant. of Egypt.
" 16—Dr. Crandall, on Animal Physiology.
" 20—Prof. Bush, on Champollion's method of deciphering the Hieroglyphics.
" 23—L. D. Chapin, on the Antiquities of America.
" 27—Dr. Weldon, on the Hydro-oxygen Microscope, with experiments.

16. *Minerals, Ores, Mines, &c. examined.*—W. W. Mather, Mineral Surveyor, Mining Engineer, Chemist and Metallurgist, and late Instructor in Chemistry, Mineralogy and Geology, and the applications of these sciences to the useful arts, at the U. S. Military Academy at West Point, has established an office for the analysis and assay of minerals and ores; for the examination of mines, mining districts, mineral beds, quarries and quarry-stones; for communicating information upon the best methods of smelting and working ores and minerals to bring them to a marketable state; and for imparting all the various knowledge which is a necessary preliminary to the successful prosecution of mining enterprises. So many mining operations are undertaken through mistaken views of their probable productiveness, and even of the nature of the mineral or ore, that it is deemed necessary for the public interest that an office similar to that mentioned should be established. This professional knowledge is as important to the community, to prevent the undertaking of mining and metallurgic operations where they would be unproductive, as to guide and direct enterprise to the most economical and profitable methods of working mines and preparing their marketable products.

Mr. Mather has had an experience of several years in the different branches of his profession, and now solicits the patronage of the public. The office will impart information, not only upon the subjects above mentioned, but upon the applications of all mineral substances to the various useful purposes of life.

Letters, post paid, addressed to W. W. Mather, Mining Engineer, No. 95 State-street, Albany, soliciting information, and enclosing a fee of five dollars, will be promptly attended to. Should it be necessary to examine the locality of the mineral or ore, or make an assay or chemical analysis, or make drawings, and give descriptions of machinery, furnaces, &c. &c. an additional fee will be charged, varying in amount according to circumstances.

17. *Mineralogical and Geological Collections.*—Messrs. Mather & Hall have large collections of mineral, fossil and geological specimens, to illustrate American Mineralogy and Geology, which they will sell at reasonable rates. They will pack and forward sets of mineralogical specimens, well characterized, of fine quality, and many of them crystallized, to any part of the United States or to Europe, at the following rates, viz:

100	specimens	two	by	three inches,	$25
200	"	"	"	"	60
300	"	"	"	"	100
400	"	"	"	"	150
500	"	"	"	"	225
900	"	"	"	"	300
1000	"	"	"	"	600
2000	"	"	"	"	1500

The reason that the prices increase more rapidly than the numbers of specimens, is the increasing difficulty of procuring varieties of appearance and new species, after collections of a few hundreds have been formed.

Fossils to illustrate the fossil zoology and botany of the transition slates, graywackes and limestones; the coal formation and associated rocks; and of the upper, secondary and tertiary formations, will be sent to order at the above rates.

Geological specimens, two by three inches, will be furnished at two thirds the above rates; of three by four inches at the above prices. Larger geological specimens will be procured if desired, at a moderately increased price.

Small mineral specimens will be furnished to those wishing them at reduced prices.

Plaster of Paris trays to lay the specimens in, in the Cabinet, made very neatly and of perfect whiteness, will be sent to those desiring them at six dollars per hundred. Individuals or institutions who wish it, can have their specimens put up in elegant cases of drawers, or in those made plain, as may suit the views of the purchasers.

Orders for large collections will be given a year in advance of the time of their fulfillment. Payments are to be made one half in advance on giving the order, the other half on the receipt of the collection.

Orders for collections, or for particular specimens, are to be addressed, post paid, to Messrs. Mather & Hall, No. 95 State-street, Albany.

Albany, Dec. 17th, 1836.

We recommend the above design and the gentlemen who have undertaken it, as being worthy of confidence.—Ed.

18. *Geology and Mineralogy considered with reference to Natural Theology*, by the Rev. William Buckland, D. D., Canon of

Christ Church, and Reader in Geology and Mineralogy in the University of Oxford. 2 Vols. 8vo. Vol. I. 600 pages. Vol. II. consisting of 69 plates; with 110 pages of description, and 18 of Index. Plate 1 is a universal geological section, colored for the various formations; this section is 4 feet long, and 9 inches wide.

Within the last days of finishing our present No. we have received from the respected author this long desired work. There is now neither time nor space to do much more than to announce it to our readers. It deserves a full analysis, although it would be difficult to do it justice, without the splendid graphic illustrations, by which it is accompanied.

We have read this work with a degree of satisfaction and admiration which has increased at every step.

It is a full digest of the most important facts in geology, happily combined, with great condensation and perspicuity, and by the most liberal use of plates beautifully executed, it speaks intelligibly to the eyes, even of those who are not familiar with the language of natural history, and thus it displays the astonishing structure of the world.

This work cannot be cursorily and rapidly read, with any advantage; it demands study and care on the part of the reader, as it has evidently cost much time and labor to the writer.

The great moral demonstration which is its main object, is fully sustained, and we think that no man can rise from the *intelligent* perusal of it, without a full conviction that a creating and governing mind, infinite in power, knowledge, wisdom and benevolence, has gradually arranged the materials of this planet, and caused to be interred in its strata and mineral masses, documents of its history, and of that of innumerable races of animals and plants, from the most microscopic to the most colossal, which lived and died ere man appeared—documents surpassing in number and in credibility every thing of actual history, except the inspired record itself.

With this record we believe these facts to be entirely consistent, and we are fully assured that ignorance of them is the sole cause of the incredulity and displeasure which are manifested by some as to the moral bearing of geology.

We cannot now enter upon this argument, and can only say in conclusion, that Dr. Buckland has by the present work, laid both science and religion under great obligations,—while he will delight all his readers by the vigor, beauty and eloquence which give his work as high a rank in literature as it claims in science.

19. *Lyceum of New York.*—This fine institution now appears with renovated vigor. Aided by the liberality of citizens of New York, it has erected a large and elegant building in the upper part of Broadway, containing all desirable accommodations for its extensive museum and library, for its lectures and various pursuits.

It has recently issued a new No. of its annals, being the conclusion of Vol. III, of 437 pages. This No. is entirely occupied by a botanical paper by Prof. John Torrey, being a monograph on North American Cyperaceæ; to which is added a catalogue of officers, &c.

This paper we are assured is characterized by the author's well known acuteness and accuracy, and will without doubt add to his reputation, and to that of the Lyceum, as well as to the stock of botanical knowledge.

We understand that the Lyceum is to be opened to the public for courses of lectures, to be given by different gentlemen during the current winter, and that Dr. Francis will deliver the introductory discourse.

20. *A Synopsis of the family of Naiades*, by Isaac Lea, Mem. of the Amer. Philos. Soc. &c. &c. Philadelphia: Carey, Lea & Blanchard. London: John Miller.—At the last moment this beautiful little work has been placed in our hands. We presume that conchologists will find it to be another elegant and accurate addition to the valuable contributions heretofore made by Mr. Lea in this department of Natural History.

21. *Conrad's Unionidæ, &c.*—Judah Dobson, Philadelphia, has published, and now ready for sale, *Conrad's Unionidæ*, No. 7; also Dr. Holbrook's *North American Herpetology*, Vol. I, with splendid colored plates, in royal 4to.

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22. *Obituary**—the late Mr. George Chilton. This excellent chemist and most worthy man, was extensively known to the cultivators and amateurs of science, not only in this country, but in Europe. He was a native of England, and emigrated to the United States in the year 1797, at the age of thirty. Soon after he settled in New York,

* For several of the facts stated in this notice, we are indebted to a notice signed J. T. published in the New York American of Nov. 17, 1836.

he commenced a course of instruction in chemistry, natural philosophy, and astronomy. Among the gentlemen who attended his early lectures, were the late Dr. Mitchell, President Vethake, G. C. Verplanck, Esq. and the late Dr. Bruce.

Dr. Kemp of Columbia College, and Dr. Romeyn, were his firm friends and patrons, as, indeed, were most of the prominent and scientific men of our city at that time. In 1803, he delivered, in New York, a course of lectures on natural philosophy, to a large class of ladies, many of whom still remember the pleasure and profit they derived from them. In 1805, when the yellow fever prevailed in New York, Mr. Chilton was invited to deliver a course of lectures on chemistry and natural philosophy at Newark, in which he succeeded to the satisfaction of his numerous hearers.

He commenced the manufacture of the chrome yellow in 1808, but had the greatest difficulty in prevailing upon the painters to make trial of it. After their prejudices were overcome, the demand for it rapidly increased, and had he but gone more largely into the manufacture, he doubtless would have realized an independent fortune by it. He continued making it until the company at Baltimore reduced the price so low that it became no longer a source of profit. It is gratifying to his friends to observe, that even to this day a dollar a pound is offered in New York, by several chair painters, for the article such as he used to manufacture; the price of the chrome yellow commonly sold being but twenty eight cents.

In 1811, he established a laboratory in New York, for the manufacture of the pigments of chrome, from the ore discovered a short time before in the neighborhood of Baltimore, and also for the preparation of the finer chemical articles. Shortly after the late war with England was declared, he removed to Scotch Plains, in New Jersey, to take charge of the powder mills of Decatur & Atterbury. Here, however, he still continued the manufacture of chemical products, a laboratory having been provided for him by the proprietors of the mills. In 1822 he returned to New York, and established himself as an operative chemist and analyst. He also manufactured and imported materials and philosophical apparatus for numerous colleges and institutions of learning. Shortly after his return to New York, he delivered, by invitation, a popular course of scientific lectures to a large class, in St. Stephen's church in this city. In 1823 Prof. Silliman, who was prevented by ill health from attending to the duties of his professorship, engaged Mr. Chilton to act as his

substitute, in delivering the chemical lectures in the laboratory of Yale College, which is a sufficient evidence of the estimation in which he was held by that gentleman.

In this course, he acquitted himself with his wonted ability, exhibiting an accurate acquaintance with the state of the science, while in the experimental illustrations he was ably assisted by Sherlock J. Andrews, Esq. then an experienced assistant in the department of chemistry, mineralogy and geology in Yale College, and now an eminent lawyer in Cleaveland, Ohio.

Mr. Chilton's mind was early directed to inventions relating to science and the arts. He invented an hydrometer, which in accuracy is thought to be superior to any other, and may probably be hereafter made known to the public. The account of his rain gage was published in this Journal, Vol. VII, p. 326.

He constructed also a barometer, and some of these instruments have been sold and have given great satisfaction. A hydrographic map of his invention was pirated, and a patent taken out for it by some one who had no claim to it.

He made various improvements in chemical as well as other apparatus. He was naturally possessed of a great deal of mechanical ingenuity, and owing to the difficulty of procuring, at that time, the necessary instruments, he himself constructed the whole of his beautiful philosophical and astronomical apparatus.

In July, 1834, Mr. C., for the benefit of his health, and also for professional improvement, made a visit to Europe, from whence he returned in August, 1835. He was favorably received by many of the scientific men of England, Scotland and France. He attended the meeting of the British Association, at Edinburgh, and prepared a paper for that learned body, which the celebrated Dalton volunteered to present.

Mr. C. appeared to be greatly improved in health by his visit to the old world, but shortly after his return his strength declined, and his old disease, which was hydrothorax, with an enlargement of the heart, returned, so that he was unable to attend to the duties of the laboratory.

Although Mr. Chilton was a laborious chemist, and was accomplished in his profession, he published but little. To the Mineralogical Journal of the late Dr. Bruce, he however contributed several valuable articles, and some of his papers are inserted in this Journal. His reputation as a scientific and practical chemist was so ex-

tensive, that for many years he was consulted in the line of his profession by persons in all parts of our country, and in the city of New York, in almost every case that occurred in the courts of justice, where the opinion of an accurate chemist was needed, Mr. C. was the person selected. As a private citizen and friend he was greatly respected for his virtues and his amiable character; in the domestic circle he was affectionate, and in his protracted and painful illness he was sustained by the hopes of the Christian.

He retained his interest in science even after his infirmities became both distressing and alarming. He brought with him from Europe the latest improvements in apparatus and processes, and was always frank and liberal in communicating his knowledge. He was the principal mover of the effort to arrange the public course of geology, which was given in April and May, 1836, in Clinton Hall, and although his unrelenting malady, which then pressed heavily upon him, prevented his attendance on the lectures, he participated with a most respectable audience, in the interest excited by that sublime and delightful science.

We understand that the well known establishment, 263 Broadway, for chemical and philosophical apparatus and supplies, so ably and faithfully conducted by the late Mr. Chilton, will be continued under the care of his son, Dr. James R. Chilton. This gentleman, trained by his father, and having already much experience in the business, is well worthy to receive a transfer of the confidence so long reposed in his predecessor. From much experience of the fidelity and capacity of this house, we can and do cordially recommend it to all who may have need of such assistance, or of the efforts of analytical skill. We understand that the department of analysis will be conducted as heretofore. It is a subject of congratulation to the cultivators of science, that this country now affords so many facilities for its prosecution, and the establishment mentioned above is well entitled to rank among the best in the United States.

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ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

In public, it is rarely proper to advert to personal concerns; to excuse, for instance, any apparent neglect of courtesy, by pleading the unintermitting pressure of labor, and the numerous calls of our fellow-men for information, advice, or assistance, in lines of duty, with which they presume us to be acquainted.

The apology, implied in this remark, is drawn from me, that I may not seem inattentive to the civilities of many respectable persons, authors, editors, publishers, and others, both at home and abroad. It is still my endeavor to reply to all letters which appear to require an answer; although, as a substitute, many acknowledgments are made in these pages, which may sometimes be, as now, in part, retrospective.—*Ed.*

DOMESTIC.

The Dispensatory of the United States, by Drs. Wood and Bache. Third edition, Philadelphia, 1836. From Dr. Bache.

The American Almanac, for the year 1837. From Mr. J. E. Worcester.

Elements of Botany, by Asa Gray, M. D. New York, 1836. From the author.

Chemical and Medical Researches on Kreosote, by E. Miguel. From the translator, Wm. Wetherell, M. D.

Essay on the Laws of Acoustics, by J. Togno, M. D. Philadelphia. From the author.

Experiments to establish a peculiar Physico-organic action, inherent in the Animal Tissues; by J. Togno, M. D. From the author.

Annual Report of Dr. Togno's Infirmary. From the author.

Improvements in the Manufacture of Sugar, by T. Judd, Esq. From J. Vaughan, Esq.

Syllabus of a course of study for the S. C. Female Collegiate School, during its vacation. Columbia, S. C. 1836. Anonymous.

Transactions of the Albany Institute, Vol. II, Part II. From the Institute.

Report on introducing pure water into the city of Boston, by Loammi Baldwin, Esq. C. E. Second edition. From the author.

Discourse before the Alumni of the University of Pennsylvania, by Thos. J. Wharton, Esq. Philadelphia. From the author.

Diagrams for illustrating the direction of the Wind, by A. D. Bache, M. D. From the author.

Report of the Geological Reconnoissance of the State of Virginia, by Prof. William B. Rogers. From the author.

Description of a new species of the genus Unio, by Isaac Lea, Esq. From the author.

Hinman's Connecticut Antiquities. From the agent, I. Webster.

Connecticut Historical Collections, by J. W. Barber. From the author.

Dr. Haxall's Dissertation on diseases of the abdomen and thorax. From the author.

Journal of the Essex County Natural-History Society, Vol. I, No. 1. From the Society.

Jewett's Advertiser—Medical and Physical Research, Vol. II, No. 10. Columbus, Ohio.

A new theoretical and practical treatise on navigation, &c. &c. by M. F. Maury, passed midshipman U. S. N. 1836. The author.

Louis, of Paris, (France,) on Fevers, translation in two vols. 8vo. by Dr. H. T. Bowditch of Boston, and presented by him, through the Ed. Am. Jour., to the Lib. of Med. Institution of Yale College.

Permanent temperance documents, an 8vo. volume, being a copy from among 300 copies presented to the officers and students of Yale College, by E. C. Delavan, Esq. of Albany.

The American Medical Library. Philad. (Specimen sheet.)

A Catalogue of Recent Shells, with descriptions of new or rare species in the collection of John C. Jay, M.D. &c. The author.

Annual Report of the Board of Managers of the Prison Discipline Society, Boston.

Annals N.Y. Lyceum, Vol. III, Nos. 6—14. From the Lyceum.

Geological Report, by G. W. Featherstonhaugh, Esq. Two copies, from Col. Abeel and L. H. Machen, Esq.

Catalogue of Randolph-Macon College, Va. From Prof. Tolefree.

Extracts from the Correspondence of the American Bible Society.

Catalogue of Amherst College, 1836–7. From Prof. Hitchcock.

A Synopsis of the family of Naiades, by Isaac Lea. Philadelphia. From the author.

Beautiful Bituminous Coal, from Brookfield, Trumbull Co. Ohio, near the Pennsylvania line. From J. Dart, jr. Buffalo.

FOREIGN.

Wood's Grammar of Elocution. London. From the author.

Neues Jahrbuch der Chimie und Physik. Heft 23 und 24. Halle.

Proceedings of the Royal Society of Edinburgh. Nos. 7 and 8.

Chemical Tables of the properties of simple and compound bodies, by Prof. Is. F. W. Johnston, Durham, (Eng.) From the author.

The Mining Journal and Commercial Gazette, Nos. 47 to 59 inclusive. London. From Henry English, Esq. Editor.

The Third Annual Report of the Royal Polytechnic Society, England, 1835. From the Committee—L. Squire, Secretary.

Geology and Mineralogy considered with reference to Natural Theology, by Rev. Wm. Buckland, D. D. &c. 2 vols. 8vo. Vol. II, plates and description. From the author.

Several scientific papers, by Mr. Faraday, F. R. S. The author.

Proceedings of the Geological Society of London, 1835–6, No. 46. From the Society.

ACKNOWLEDGMENTS TO CORRESPONDENTS, FRIENDS AND STRANGERS.

Remarks.—This method of acknowledgment has been adopted, because it is not always practicable to write letters, where they might be reasonably expected; and still more difficult is it to prepare and insert in this Journal, notices of all the books and pamphlets which are kindly presented, even in cases, where such notices, critical or commendatory, would be appropriate; for it is often equally impossible to command the time requisite to frame them, or even to read the works; still, judicious remarks, from other hands, would usually find both acceptance and insertion.

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DOMESTIC.

Plan of Wier's Cave, with a box of its stalactites and crystals. From Mr. Cook, of Staunton, Virginia.

An Address to the American People.

Annual Report of the Trustees of the Massachusetts General Hospital, for the year 1835. From Dr. Lee.

Scientific Tracts, Vol. I. No. 1. Boston, April 1st, 1836.

An Address, by S. F. Austin, of Texas. Two copies. Lexington, Ky. 1836.

Memoirs on the Nature of Miasm and Contagion, by John L. Riddell, M. D. Cincinnati, 1836. From the Author.

Seventeenth Annual Report of the N. York Deaf and Dumb Institution.

The Bookseller's Advertiser. New York. Vol. II. No. 1. 1836. Two copies.

Hilliard, Gray & Co.'s Literary Advertiser. Boston, Jan. 1836.

Minutes of the General Assembly of the Presbyterian Church. Philadelphia, 1836.

A second supplementary Catalogue of the Plants of Kentucky. From H. A. Griswold.

Mr. Simons's Address before the American Antiquarian Society. Worcester, 1836.

Catalogue of South Carolina Medical College, 1836. From Prof. C. U. Shepard.

Nine Plates of the Journal of the Academy of Natural Sciences, Philadelphia. From the publishing committee, through Mr. M'Ewen and Messrs. Carey & Hart.

Report on Intemperance. Philadelphia. From J. S. Littell, Esq.

The Mathematical Miscellany, published by C. Gill, Flushing, L.I. 1836.

Notes on some of the Questions decided by the Board of Commissioners under the Convention with France, of 4th July, 1831. From J. K. Kane, Esq.

Inaugural Address of the Rev. Gilbert Morgan, President of the Western University of Pennsylvania. From the Author.

Third Annual Report of the State Lunatic Hospital at Worcester, December, 1835.

Wiley & Long's Catalogue of English Books recently imported. From the publishers. 1836.

Catalogue of Books in the various departments of literature, for sale by Wiley & Long. 1836.

The World of Instability, a Poem, with Notes. Philadelphia, 1836. From the author.

Dr. M'Clellan's Valedictory Address. Philadelphia, 1836. From the author.

Report on the Pacific Exploring Expedition. Washington, 1836. From J. N. Reynolds, Esq.

Scientific Tracts, Vol. II. No. 13. From the author.

Extracts from the Correspondence of the American Bible Society, No. 8. New York.

American Historical Magazine, Vol. I. Nos. 1, 2, 3.

Address before the Frederick Lyceum. Baltimore, 1836.

Scientific Tracts for the Diffusion of Useful Knowledge, Vol. I. Nos. 1, 2, 3. From the publishers, Light & Stearns, Boston.

Mr. Dillingham's Discourse before the Chester County Cabinet, 1835. From Dr. Darlington.

Carpenter's Family Medicine Chest. From the author, Mr. Geo. W. Carpenter, Philadelphia, 1835.

Supplementary Catalogue of Ohio Plants, by John L. Riddell, M. D. Adjunct Prof. Chem. Cin. Med. Col. 1836.

Anniversary Oration before the South Carolina Society for the Advancement of Learning, by the Hon. Wm. Harper.

An Essay on the Abolition of Slavery, by Geo. A. Baxter, D. D. Richmond, 1836. From Mr. W. B. Dutton.

Meteorological Observations and Essays—for the Appendix to the Report of the Regents of the University of the State of New York, for 1836, by B. F. Joslin. From the author.

Report of the Secretary of the Treasury on Commerce and Navigation, for the year ending Sept. 30, 1835. From Hon. J. Davis, U. S. Senate.

Annual Report of the Regents of the University of New York, No. 83, 1834—late Chancellor Dewitt.

Address of Gov. Davis of Massachusetts. From Lieut. Gov. Armstrong.

Documents relating to the Survey of Massachusetts. Id.

Report on Indian Affairs, No. 474—May, 1834.

Report on Post Office and Post Roads, No. 422—1834.

Mr. Clay's Report on Foreign Relations. From late N. Smith.

Description of Rev. Dr. Prince's new Stand for a Reflecting Telescope. From Francis Peabody, Esq.

J. Olney's History of the United States. From Durrie & Peck.

Dr. Hare on Experimental Improvements in Apparatus and Manipulations. From the author.

American Advocate of Peace, conducted by C. S. Henry.

The Structure of the Eye with Reference to Natural Theology, by Wm. C. Wallace, Oculist, &c. From the author.

American Almanack and Repository of Useful Knowledge, for 1836. From J. E. Worcester.

Dr. Comstock's Outlines of Geology, 2d edition. From the author.

Dr. Franklin Bache's Turner's Chemistry, 5th Am. Ed. From the Editor.

Elements of Chemistry, by F. J. Grund. From the publishers, Carter, Hendee & Co.

Rev. Dr. Codman's Visit to England. From the author.

Dr. Gray's Elements of Botany. From the author.

Familiar Conversations on the Constitution of the United States, by B. E. Hale. From the publisher.

Report on the Coal and Iron of the Maryland Mining Company, by G. W. Hughes. U. States Civil Engineer. From the author.

Proceedings of the Connecticut Medical Society, 1836.

Mechanic's Magazine, &c. Feb. 1836.

Eighth Annual Report of the Young Men's Temperance Society, New Haven, June, 1836.

Triennial Catalogue of Williams College, 1835. From Dr. J. Porter.

Report of the Executive Committee of the American Union.

Medical Properties of the Grey Sulphur Springs of Virginia. 1836.

Dr. Baxter's Essay on the Abolition of Slavery. From G. W. McPhail.

A Geological Ramble, by J. S. Riddell.

Report on Meteorology, and Circular. From Israel Espy, Chairman.

Wet Prairies of Ohio. From Dr. Wm. Wood.

Radiating and Absorbing Power of Surfaces, &c. From Prof. A. D. Bache.

Diagrams of the Direction of the Wind. Id.

Synopsis of a Course of Mineralogy, by F. Hall, M. D. &c.

Geological Features of Ohio, by J. S. Riddell.

Annual Report of the American Education Society, 1836.

Biographical Sketch of Thomas Say, by B. W. Coates, published by committee of Acad. of Nat. Scien.

Naval Magazine, Vol. I. No. 1. From Rev. C. S. Stewart.

Annual Report of the Female Benevolent Society of New York, 1836.

McDowell's Refutation of Himself. From C. C. Darling.

Lectures before the Mercantile Library Association of N. York. From the Board of Directors, 1836.

The Schoolmaster and Advocate of Education.

Remarks on Literary and Moral Concert in the Valley of the Mississippi, by Dr. Daniel Drake. From the author.

Analysis of the Derivative Words in the English Language, by Salem Town, A. M. From the author.

Constitution of Young Men's Association of Buffalo. From the association.

Scientific Tracts, Nos. 1 to 5 inclusive. From Light & Stearns, Boston.

Essay on the Manufacture of Iron with Coke.

Third Annual Report of the Missionary to the Negroes in Liberty County, Georgia. From Is. S. Bullock.

Catalogue of Plants growing without cultivation in the vicinity of Troy. From Dr. Wright and James Hall, A. M.

Temperance Convention, Boston, Sept. 1835.

Mr. Eliot's Address at the opening of the Odeon, Boston, Aug. 1835. From the author.

Documents on the State Prison of Massachusetts, Nos. 2 and 6.

Carpenter's Annual Medical Advertiser, for 1836. From the author.

Third Annual Report of the Bishop White Prayer Book Society, Philadelphia. From John S. Littell.

Dr. Herman Bokum's Lecture on the German Language and Literature, Feb. 1836, Boston. From the author.

American Lyceum, Transactions of the Sixth Annual Meeting, No. 1. Sixth Annual Report.

Rev. C. W. Upham's Discourse at the Funeral of the Rev. John Prince, LL. D. June 9, 1836. From the Author.

FOREIGN.

Recherches sur les Poissons Fossiles, par L'Agassiz, Cinquieme Livraison: the 1st, 2d, 4th and 5th, have been received; the 3d is wanting. From the author.

Prof. J. D. Forbes' Experiments on Electricity of the Tourmaline and other Minerals, by Heat. From the author.

Prof. Sedgwick (Univ. Cambridge, Eng.) on the General Structure of the Cambrian Mountains.

The same, on the Structure of Large Mineral Masses.

The same, Description of Sections in the Carboniferous Chain between Penigent and Kirkby Stephen. All from the author.

Lethea Geognostica, by Prof. H. G. Brown, Univ. Heidelberg. From the author.

Dr. Hibbert on the Fresh-Water Limestone of Burdie House, near Edinburgh. From the author.

Nouvel Abrégé de Geographie Moderne, Quebec. From Rev. J. Holmes, the author.

Outlines of Mineralogy, Geology and Mineral Analysis, two vols. octavo, by Prof. Thomas Thomson. From the author.

O. Rich's Bibliotheca Americana Nova, 1701 to 1800, 8vo. 423 pages. From the author.

Instructions for Meteorological Observations in South Africa, by Sir John F. W. Herschel.

Sopra I. Vulcani Estinti Del Val Di Noto. From Prof. C. Gemmellaro.

Relazione del Viaggio a Stuttgard. Id.

Proluzione All Anno Scolastico 1832, 1833. Id.

Relazione Academica Dell Anno XI. &c. Id.

Introduction a Une Theorie General de L'Universe. From P. E. Morin.

A Treatise on the Physiology and Pathology of the ear, by John Harrison Curtiss, Esq. sixth edition, London, 1836. From the author.

Tabulæ Anemologicæ or Tables of the wind, No. 1. by W. R. Birt, London, for Jan. and Feb. 1835.

Premiums by the Society of Arts, &c., London, 1836.

Separation of Arsenic, the same.

Letter from Mr. N. B. Ward, to Sir W. J. Hooker, on the growth of plants without open exposure to air, London, May, 1836.

GEOLOGICAL DRAWINGS AND ILLUSTRATIONS.

Mr. Robert Bakewell, Jr., son of the author of the well known system of Geology, executes geological drawings with great precision and effect. Accustomed in former years, to make geological excursions with his father, and to sketch for his works, he unites the tact of an expert artist with a perfect comprehension of the design, and thus is enabled to produce a fine result. To principals and professors of colleges, academies, lyceums, and other literary institutions, and to other scientific persons, it must be interesting to be informed, that Mr. Bakewell keeps on hand, drawings and diagrams, illustrative of the science of geology, comprising stratification, metallic veins, organic remains, active and extinct volcanoes, &c. &c. The drawings are fixed on rollers, adapted for lectures. Letters addressed to R. Bakewell, instructor of drawing and perspective in Yale College, at Mr. Eben. Johnson's, Chapel street, New Haven, will be duly attended to.

We have great pleasure in recommending Mr. Bakewell and his works as entirely worthy of public confidence; and the editor of this Journal, (as a public teacher of geology,) can speak from considerable experience of the perfect intelligibleness and great attractiveness of Mr. Bakewell's geological drawings, both in popular and in university courses. This gentleman has, in the same manner, beautifully illustrated a course of anatomy, and his talents and attainments are adequate to any thing which may admit of illustration by the graphic art.—*Editor.*

During an absence of the editor of this Journal, since the last week in August, various communications have arrived which he has, as yet, been unable to examine. They will be attended to as soon as practicable.

October 1, 1836.

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THE

AMERICAN JOURNAL

OF

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